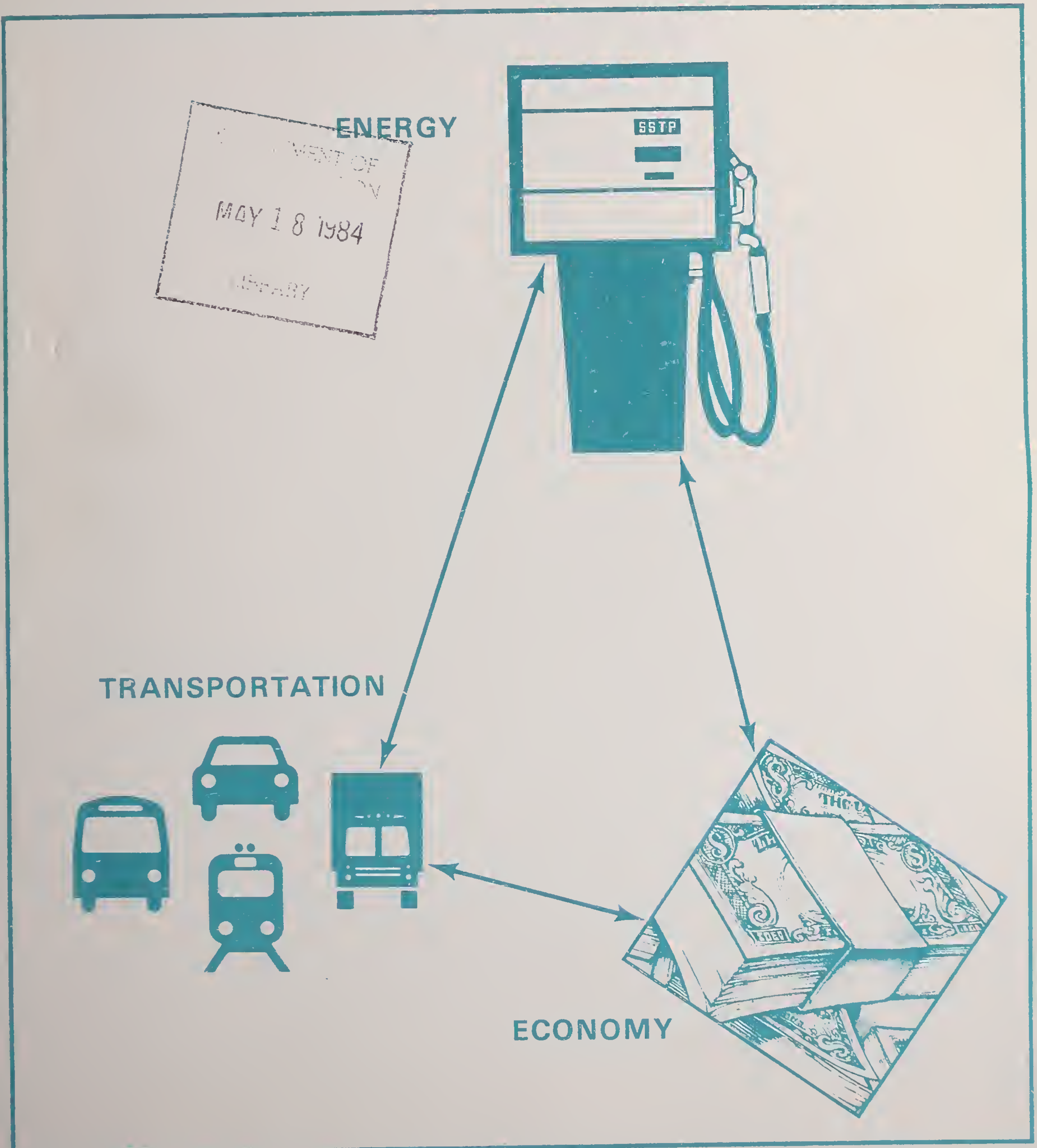
U.S. Department of
Transportation

Incorporating Energy Conservation into the Transportation Planning Process:

Mid-Sized Areas

March 1983



Incorporating Energy Conservation into the Transporation Planning Process:

Mid-Sized Areas

March 1983

Prepared by
Barry Alberts
Northern Middlesex Area Commission
144 Merrimack Street
Lowell, Massachusetts 01851

Prepared for
Federal Highway Administration
U.S. Department of Transportation
Washington, D.C. 20590

In cooperation with
Urban Mass Transportation Administration
and the U.S. Department of Energy

Distributed by
Technology Sharing Program
Office of the Secretary of Transportation

DOT-I-83-32

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Incorporating Energy Conservation into the Transportation Planning Process in Mid-Size Areas		5. Report Date March, 1983
		6. Performing Organization Code
		8. Performing Organization Report No.
7. Author(s) Barry S. Alberts		
9. Performing Organization Name and Address Northern Middlesex Area Commission 144 Merrimack Street Lowell, Massachusetts 01852		10. Work Unit No. (TRAIS)
		11. Contract or Grant No. DTFH61-81-C-00087
12. Sponsoring Agency Name and Address U.S. Department of Transportation* Federal Highway Administration (HHP-23) Urban Mass Transportation Administration Washington, D.C.		13. Type of Report and Period Covered Final Report 1981-1982
		14. Sponsoring Agency Code

15. Supplementary Notes

*Co-sponsored by the U.S. Department of Energy, Washington D.C.

16. Abstract

This report describes the methods by which mid-size Metropolitan Planning Organizations (MPOs), between 200,000 and 750,000 in population are incorporating energy conservation concerns into their urban transportation planning process. Nine MPOs were selected for case study analysis. General conclusions were extrapolated from these case studies.

The study found that the particular characteristics of these areas, such as travel patterns and spatial patterns, tend to inhibit energy conservation efforts in the transportation sector, and that some strategies which have been used in larger metropolitan areas may not apply in mid-size areas. Nevertheless, MPOs do consider energy use within their planning processes in a variety of ways: adopting of energy goals, determining the energy consumption of network alternatives, assessing energy impacts of TSM, etc.

These findings suggest a number of roles for mid-size MPOs regarding energy conservation: educating the public; analyzing traffic flow improvements for their energy impacts; encouraging ridesharing alternatives; and utilizing energy consumption as one program and project assessment criterion.

17. Key Words Metropolitan Planning Organization; energy conservation; mid-size areas; 3-C process; energy impact analysis; case studies	18. Distribution Statement

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
unclassified	unclassified	160	

Form DOT F 1700.7 (8-72)

FOREWORD

The shortages of gasoline in the 1970's influenced metropolitan planning organizations to plan for a variety of transportation measures designed to maintain mobility and save gasoline. For the most part, information on how large metropolitan areas planned to abate the impacts of the shortage is extensive. However for "mid-sized" metropolitan areas, areas between approximately 200,000 and 750,000 in population, little information exists about both the nature of the shortages' impacts and how the urban transportation planning process was able to deal with the impacts.

The purpose of this study was to address this lack of information and to assess the current status of energy planning. Interestingly, many mid-sized areas only felt the minor impacts of the shortages, because of either the travel or spatial patterns unique to mid-sized areas. Nevertheless, mid-sized metropolitan planning organizations currently are continuing a modest level of effort in energy planning, especially in those cases where energy objectives can be accomplished in concert with transportation project objectives. We believe that this report provides a good summary of current energy activities at metropolitan planning organizations in mid-sized areas and makes useful suggestions on this question. We believe that it will be helpful to metropolitan planning organizations of all sizes who are interested in pursuing activities on energy-related topics.

Related reports are available on Transportation Energy Contingency Planning, Transportation Energy Management, Scenario Planning and Estimating Transportation Energy Consumption of Residential Land Use Types. Information on these reports is available from our offices. Additional copies of this report are available from the National Technical Information Service, Springfield, Virginia 22161. Please reference report DOT-I-83-32 on your request.

Charles H. Graves
Director, Office of Planning Assistance
Urban Mass Transportation Administration
U.S. Department of Transportation
Washington, D.C. 20590

Alfonso B. Linhares
Director, Office of Technology
and Planning Assistance
Office of the Secretary
U.S. Department of Transportation
Washington, D.C. 20590

Kevin E. Heanue
Director of Highway Planning
Federal Highway Administration
U.S. Department of Transportation
Washington, D.C. 20590

TABLE OF CONTENTS

		Page No.
Chapter I.	INTRODUCTION	
	a. Purpose of Study	1
	b. Background & Issues	2
	c. Study Approach	4
	d. Selected Case Studies	5
Chapter II.	PERSPECTIVES ON ENERGY CONSERVATION	
	a. Background	6
	b. Potential Metropolitan Planning Organization (MPO) Activities	6
	c. Analysis Structure	8
Chapter III.	COMPARATIVE ANALYSIS OF CASE STUDIES	
	a. Area Characteristics & MPO Activities	10
	1. Area Characteristics	10
	2. MPO Structure & Staff	15
	3. Transportation Network Characteristics	18
	4. Technical Capability & Data Collection	24
	b. Overall Energy Considerations	31
	1. Impact of Recent Energy Shortages	31
	2. Local Efforts	34
	3. Standard Energy Related Activities	37
	4. Transportation Improvement Programs	43
	5. Transportation Systems Management; Air Quality	46
	6. Long Range Planning	57
	7. Special Energy Conservation Activities	63
	a. Separate Energy Conservation Planning	64
	b. Energy Conservation Policies	69
	c. Energy/Transportation Issues Papers	71
	d. Areawide Energy Consumption Estimates	75
	8. State Guidance on Energy Conservation	77
Chapter IV.	FINDINGS AND CONCLUSIONS	
	a. Factors of Influence	86
	b. Energy Conservation Priorities	89
	c. Role of Energy Conservation	92
	d. Appropriate MPO Roles Regarding Energy Conservation	94

Page No.

APPENDIX A: CASE STUDY SUMMARIES

Tucson, Arizona 99
Colorado Springs, Colorado 104
Jacksonville, Florida 110
Albuquerque, New Mexico 115
Akron, Ohio 120
Eugene-Springfield, Oregon 124
Lehigh Valley, Pennsylvania 130
Nashville, Tennessee 134
Beaumont/Port Arthur, Texas 140

APPENDIX B: ADDITIONAL INFORMATION AND CALCULATIONS

Albuquerque: Potential Energy Conservation Measures 145
Gas Consumption Calculation for Bernalillo County 148
Lane Council of Governments (LCOG) Summary of Transportation Energy Conservation Policies 150
Akron Metropolitan Area Transportation Study (AMATS) Evaluation of Transportation Energy Conservation Actions 152
Transportation Energy Efficiency Manual (TEEM) Energy Calculations 158
Energy Conservation Reduction and and Safety Program (ECONS): Sample Calculations 160

LIST OF FIGURES

1.	Population Growth 1970-1980	2
2.	Urban Area Populations	10
3.	Case Study Area Characteristics	12
4.	University Facilities in Study Areas	13
5.	MPO Staff Characteristics	16
6.	Area Traffic Characteristics	19
7.	Traffic Network Problems	21
8.	Energy Considerations in UTPS Travel Forecasts	25
9.	Modelling Capability	27
10.	Surveillance Activities	29
11.	Impacts of 1979 Energy Shortage	32
12.	Local Energy Conservation Support	35
13.	Energy Contingency Plans - Major Recommended Strategies	41
14.	Transportation System Management Strategies	47
15.	Tucson: TSM Evaluation Criteria	49
16.	TCM Analysis System Flow Chart	51
17.	Energy Impacts of TCM Measures	53
18.	TSM Project - Objective Matrix	55
19.	Energy Conservation in Long Range Plans	58
20.	Special Energy Conservation Activities	63
21.	Albuquerque MPO - Potential Energy Conservation Measures	65
22.	AMATS Recommended Transportation Energy Conservaton Actions	66
23.	Primary Characteristics of Possible Techniques	72
24.	TEEM Indexing of Advanced State-of-the-Art Measures	79
25.	TEEM Relative Ranking of State-of-the-Art Measures	80
26.	TEEM Interrelationships of Categories of Measures	81
27.	ECONS: Arterial Optimization Data Requirements	84

ACKNOWLEDGEMENTS

The author wishes to express his gratitude to all of the people and agency representatives within the case study areas who gave of their time to assist in the conduct of this study. Their willingness to provide any assistance that was required in an open manner was especially appreciated. Although the total number of people who provided assistance is too numerous to mention herein, the following people were particularly helpful.

Mark Petersen
PIMA Association of Governments
Tucson, Arizona

Brad Johnson
Pikes Peak Area Council of Governments
Colorado Springs, Colorado

Mary Jo Ficaro
Jacksonville Planning Department
Jacksonville, Florida

Pat Franklin
Florida Energy Office
Tallahassee, Florida

William Murphy
Akron Metropolitan Area Transportation Study
Akron, Ohio

Oliver Snowden
Lane Council of Governments
Eugene, Oregon

Joseph Quintana
The Middle Rio Grande Council of Governments of New Mexico
Albuquerque, New Mexico

Glenn Taggart
Joint Planning Commission
Lehigh-Northampton Counties
Lehigh Valley, Pennsylvania

Robert Kurzynske
Metropolitan Planning Commission
Nashville, Tennessee

Robert Dickinson
South East Texas Regional Planning Commission
Port Arthur, Texas

INTRODUCTION

A. Purpose of Study

The oil embargo of 1973 and the energy shortages experienced in various parts of the country during the summer of 1979 have served to emphasize the extent to which the nation's metropolitan area transportation systems depend upon an ample and continuous supply of fossil fuels. These "crises" suggested that energy considerations may need to be taken into account when analyzing and defining future short-term and long-term changes in the transportation system.

In recent years, progress has been made in developing innovative means of incorporating energy conservation concerns into the transportation planning process undertaken by Metropolitan Planning Organizations (MPOs). Information and guidance has been distributed by Federal transportation agencies; workshops, conferences and seminars have been conducted; special research efforts have been developed by highly respected consulting firms, etc. Additionally, efforts at encouraging more energy efficiency in large metropolitan areas have been widely undertaken and reported.

In spite of these efforts, there appeared to be a lack of specific information regarding the impact of these various efforts on the actual work activities of MPOs. This is particularly true for "mid-sized" metropolitan areas, defined for the purposes of this study as those metropolitan areas with an urbanized area population between approximately 200,000-750,000. Many of the reported efforts, and the recently developed methodologies, appear to be related primarily to larger metropolitan areas, usually those over 1 million in population.

In 1981, the Federal Highway Administration awarded six demonstration projects under an interagency research contract "Incorporting Energy Conservation into the Urban Transportation Planning Process". This research grant constituted the second phase of a two phase effort begun in 1978, and is cosponsored by the Urban Mass Transportation Administration and the Department of Energy. The objective of this project is to test innovative management programs, techniques, or procedures designed to incorporate energy conservation into urban transportation planning.

Although most of these projects were designed to develop special techniques and methodologies, the effort described herein was designed to determine the current level of effort regarding energy conservation by MPOs in these mid-sized areas. It was

hoped that a comprehensive overview of a number of representative mid-sized MPOs would indicate trends which could be used by Federal agencies to better assist these MPOs in their efforts to incorporate energy conservation in the urban transportation planning process.

B. Background and Issues

This study is limited in scope to what has broadly been defined as Metropolitan Planning Organizations (MPOs) representing "mid-sized" urbanized areas with populations roughly between 200,000 and 750,000. According to the 1980 U.S. Census, there are 77 areas with such characteristics within the United States and its possessions (for the purpose of this study, six additional areas slightly under the 200,000 threshold were also included). Significantly, the proportion of the country's population located in these areas has been increasing at a larger rate than in other areas. Between 1970 and 1980, the population of these areas increased by over 17%, more than double the rate of growth experienced in larger metropolitan areas.

Figure 1

Population Growth 1970-1980

Urbanized Areas	1970 Population	1980 Population	% Change
750,000 or more	81,148,047	87,358,759	7.65%
200-750,0000	24,946,857	29,320,657	17.53%
Less than 200,000	16,503,949	14,497,952	13.83%
New Urbanized Areas (50,000+)	-	5,387,737	-
Total Urbanized Area Population	120,512,896	138,570,902	14.6%

Source: U.S. Bureau of the Census, 1980 Census of Population

People living in these mid-sized areas now represent over 21% of all people living in urbanized areas, and if current trends continue, this percentage is likely to increase in the future.

The growth of these areas certainly has serious implications for the transportation systems within them, and for energy consumption as well. One of the attractions of these areas is a perception regarding ease of travel. These areas are generally characterized by relatively free flowing travel conditions, fairly short travel distances, lack of Central Business District (CBD) traffic and parking problems, etc. The combination of these demographic and traffic network characteristics result in a situation of increased vehicle miles travelled and areawide energy consumption, with a reduction in per capita energy consumption due to either the purchase of more fuel efficient vehicles or to a relocation into the area.

These characteristics result in a situation where more and more energy is being consumed within the transportation sector in these mid-sized areas, but public perceptions regarding energy conservation remain generally low. Furthermore, the particular development patterns of these areas and the overall densities may make certain energy conservation techniques which are appropriate and viable in larger metropolitan areas, infeasible and/or inappropriate.

This study is therefore intended to determine trends which may exist in the relationship between energy conservation and urban transportation planning in mid-sized urbanized areas. It was hoped that the answers to a number of questions concerning this issue would become clearer after studying a cross-sampling of these areas:

1. Is energy consumption within transportation sectors a concern amoung public officials and local residents?

2. Are energy consumption impacts generally considered in transportation system planning?

3. What are the limitations and constraints to an MPO's ability to consider energy in its transportation planning process, in these sized areas?

4. Are there differences in the level of incorporation of energy conservation among various MPOs in this size range?

5. What are the most appropriate and feasible methods of incorporating energy considerations into their planning process?

6. What role can the MPO play in encouraging a more energy efficient transportation system?

7. Are there ways that Federal transportation and energy agencies can provide assistance to MPO's in their efforts to consider energy use and efficiency in the transportation system?

C. Study Approach

The research has been conducted through a "case study" approach. It was determined that information regarding the MPOs which fell within the parameters of the study population would be reviewed systematically in order to determine a "representative cross-section" of such areas. Nine case study MPOs were selected as subjects of a more detailed examination by the principal researchers in order to determine the characteristics of the area, the structure of the MPO and its staff, the energy "situation" in the area, the MPO's work activities and their relationship to energy considerations. These case studies were conducted in order to provide background information for a comparative analysis of the areas. This was thought to be useful in determining whether there were particular unique characteristics that affect the ability and desire to incorporate energy concerns within the planning process.

Attempts were made to review published documents from all of the MPOs which, according to the 1980 U. S. Census, had an urbanized area population between 180,000 (the lower limit used) and 750,000, in order to determine primary selection criteria. The number of case studies was predetermined by funding and timing limitations. Information was available for 71 MPOs.

The following characteristics were used as a basis for comparison:

1. Location
2. Urbanized area size (square miles)
3. Urbanized area population (1980)
4. Urbanized area population density
5. Percentage increase in urbanized area population, 1970-1980
6. Daily vehicle miles travelled (DVMT) (1975)
7. DVMT (1980)
8. Percentage increase in DVMT 1975-1980
9. Estimated DVMT (1990)
10. Percentage increase in DVMT 1980-1990
11. DVMT per capita (urbanized area) (1980)

D. Selected Case Studies

Based on the above criteria, the following nine urban areas were selected as case study sites:

Tucson, Arizona
Colorado Springs, Colorado
Jacksonville, Florida
Albuquerque, New Mexico
Akron, Ohio
Eugene-Springfield, Oregon
Lehigh Valley, Pennsylvania
Nashville, Tennessee
Beaumont/Port Arthur, Texas

These areas were selected in order to provide a wide range of values for each criterion used, and also represent areas with significant differences in population (within the study parameters), growth rates, DVMT, topography and climate, economic characteristics, and density. A majority of the areas were expected to have some type of energy related planning activity, though not a requirement. In a number of areas, there appeared to be minimal activity. Two thirds of the case studies were engaged in some energy related activities.

E. Structure of Report

This report is divided into four additional chapters. Chapter II provides a brief perspective on energy conservation issues concerning the urban transportation process. Chapter III provides a comparative analysis of the nine MPO case studies, by MPO and area characteristics, and energy related work activities. Chapter IV summarizes the major findings and conclusions of the study. An Appendix which presents brief summaries of the individual case studies as well as some detailed calculations and information summarized within the text, complete the report.

II. PERSPECTIVES ON ENERGY CONSERVATION

A. Background

Transportation planners generally agree that the energy efficiency of a regional transportation system is certainly a significant matter and that decisions regarding alterations of the system should consider energy impacts. This is evident in the adopted goals and objectives of areawide transportation system plans and programs. Invariably, a more energy efficient transportation system is cited as a primary goal and objective.

Although there are some areas of agreement concerning appropriate means to achieve common goals, there is often disagreement as to whether there are adequate methodologies and devices available to assess impacts. Finally, there are differences as to the capacity and capability of various MPO staff to access and utilize the methodologies that exist.

It is clear, then, that energy considerations are not included within a typical transportation planning process in a standard manner. Variations based on all of the above factors exist, and the "level of effort" related to energy also varies to some extent. This has been found to be true in the areas that were used as case studies, and it can be expected that this variety exists to the same extent among all mid-sized MPOs. The hypothesis to be tested is that these "mid-sized" areas deal with energy factors somewhat differently than larger metropolitan areas, although a similar systematic analysis of the larger areas must be done and compared to this effort. However, certain "typical" energy conservation measures and activities which have been developed for larger areas may not be appropriate in smaller areas.

B. Potential MPO Activities

Energy consideration can be incorporated into urban transportation planning in a number of ways. As indicated above, there are a wide variety of opinions as to the "most appropriate" approaches that should be taken. For example, a seminar co-sponsored by the U.S. Department of Transportation and the U.S. Department of Energy in 1980* brought together

---

*U.S. Department of Energy; Energy Conservation Consideration in the Urban Transportation Planning Process, 1980, Page IX.

various participants and experts in the field of urban transportation planning to discuss some of these approaches. Some of the activities that were thought to be potentially appropriate and useful energy-related transportation functions included:

- Establish energy conservation objectives
- Prepare short-term energy crisis plans
- Strenghthen coordination among energy related governmental agencies
- Educate and inform the public
- Develop long range policy options
- Establish an inventory of transportation energy usage
- Develop energy consumption projections
- Adjust trip generation forecasts for changes in fuel price and/or availability
- Determine the costs and benefits of energy conservation programs and projects
- Define specific energy conservation projects for implementation
- Monitor changes in energy usage and travel behavior
- Encourage private sector participation in employee conservation programs

The easing of the fuel availability "crisis", and the moderation in fuel prices in the past few years may have decreased the relative importance of some of these activities, particularly in light of other priorities. In addition, the new rules and regulations promulgated by the Department of Transportation are designed to provide additional flexibility to MPOs in defining their most pressing needs and to reduce the number of mandated activities.

Nevertheless, most of the aforementioned activities did surface to one degree or another within the case study areas. Certain of these were thought by transportation planners to be more appropriate in their areas: these included contingency

planning, establishing objectives, and public education. Others, such as the tracking of energy usage over time, was more often thought to be too time consuming and having limited utility. Others were thought to be appropriate, yet difficult to undertake without major data collection and computer capabilities. Certain others, such as overall energy conservation programs, were attempted in some areas, but met with little success and public support. In many areas, MPOs were interested in pursuing various energy related activities, but felt they were unable to properly do so, given constraints in 1) staff capacity; 2) budget; 3) data; 4) modelling techniques; 5) access to methodologies; or 6) transferability of available methodologies to the characteristics of their area. These organizational and technical concerns often shaped the magnitude and the type of consideration that energy played in their overall transportation planning process.

Most of these activities surfaced to one degree or another during the case study process. Certain of them were deemed appropriate by transportation planners, such as contingency planning, establishing objectives and public awareness. Others, such as tracking energy use, was generally thought to be too time consuming and would generate limited results. Others were thought to be appropriate but difficult to undertake without major data collection or computer capabilities. Some others, such as implementing an overall energy conservation program, were attempted in some areas with little success due to lack of public support.

The types of activities that were found to be most commonly undertaken by these mid-sized MPOs can be grouped into the following categories:

1. Energy efficiency goals and objectives
2. Energy contingency planning
3. Encouragement of ridesharing alternatives
4. Data collection, monitoring, and surveillance (energy-related)
5. Energy consumption impacts of transportation system management projects
6. Fuel consumption impacts of long range network alternatives
7. Developing energy conservation strategies
8. Special energy conservation programs

Of these, numbers 1-3 were most common, 4-6 done in some cases (and to various degrees) and 7-8 were infrequently undertaken.

C. Analysis Structure

The sections that follow summarize the results of the case studies as they relate to the issues and questions discussed above. Chapter III is broken into a number of sections which describe and compare MPO and area characteristics, and any impact they might have on the MPOs energy-related activities. The second portion of the chapter deals with specific energy activities within various work elements that are being conducted or contemplated.

Chapter IV discusses the findings and conclusions of the study. Based on these findings, a discussion of suggested roles for mid-size MPOs and possible opportunities for federal assistance are presented.

A. Area Characteristics and MPO Activities

1. Area Characteristics

One of the criterion thought to be important in determining an area's ability to deal with energy issues in the transportation section was the area's physical characteristics, including the overall population and growth trends. Although "mid-sized" as defined by the parameters of this study was considered to be between approximately 200,000-750,000 urbanized area population, in fact the characteristics of areas within these two boundaries varied substantially.

Figure 2
Urban Area Populations
(Case Study Areas)

Less than 300,000	300-400,000	400-500,000	500,000 +
Eugene	Beaumont/Port Arthur	Lehigh Valley	Akron
	Colorado Springs	Albuquerque	Tucson
		Nashville	Jacksonville

The overall population totals did not appear to be highly correlated with extensiveness of energy considerations, but acted more as a surrogate for those factors which do. Smaller areas did not tend to be affected by either 1973 or the 1979 energy crisis to the degree reported in larger sized areas. Traffic congestion, which tends to make people more amenable to ridesharing and traffic flow improvements, might have been somewhat less prevalent in smaller areas, but none of the mid-sized areas had especially serious problems. The level of traffic related problems tended to be more highly correlated to rate of growth rather than absolute numerical totals.

Those areas having recently experienced or expecting to experience a high growth rate tended to have more serious travel related problems than stable areas, due to the fact that the roadway network is not able to keep up with that growth in terms of overall capacity or traffic operations. Areas such as Colorado Springs, Tucson and Albuquerque are developing traffic operations problems in certain corridors experiencing heavy economic development. The Colorado Springs area, for example, is anticipating that the 80% increase in population over the next twenty years will result in a situation where over 50% of the

system will be severely congested by the year 2000 unless over $350 million in roadway improvements will need to be put into place. Very little of the system currently experiences severe congestion.

The growth rate is more important in terms of energy considerations because strategies which reduce vehicle miles travelled (VMT) or reduce peak hour traffic will not only save energy, but can be used as methods to reduce the overall new lane miles of roadway that must be added to the system. Additionally, areas which until recently were fairly small are not accustomed to traffic congestion related problems, even on a small-scale, and are somewhat more likely to look at alternative methods to solve these problems. Older urban areas, or industrial areas, which have been fairly stable in size, have not seen marked increases in congestion problems and are less likely to consider changes to the existing system, particularly if it means altering individual travel patterns.

Only one of the case studies, Nashville, exhibited a typical metropolitan area spatial configuration, with the central business district as the overwhelmingly major generator. Eugene had this to some degree, although logging employment (which naturally occur away from the CBD) represents the major employment activity in addition to the University of Oregon. While all of the areas had a significant pull towards the downtown, only Nashville has been increasing its draw to any extent. In most other areas, this draw has been becoming weaker as suburban industrial/office parks, strip development and cross-metropolitan commuting patterns have dominated more recent development. Older cities, such as those in the Lehigh Valley (Allentown, Bethlehem, Easton), remain statistically dominant, but are reducing their influence.

These patterns have made energy conservation measures, such as express buses, HOV lanes, rapid rail lines, etc., infeasible because the areas lack a central place with high employment densities. Nashville has seen a successful express bus programs on certain high density corridors leading into the downtown, and has ordered articulated buses, some of which will be used on these express routes, but this is the exception rather than the rule.

The typical spatial pattern of residential development in all of these sized areas is low density, suburban sprawl. Areas with less than 750,000 do not seem to develop either a high density ring around the CBD or a lower density suburban area further away. Most of these areas, particularly those that have grown rapidly, have fairly small CBDs surrounded by low density development. CBD areas, particularly in the smaller areas, are

Figure 3

Case Study Area Characteristics

Urbanized Area	Square Miles	1980 Population	1970 Population	Population Growth 1970-1980	Future Growth Year 2000	Central City(s)
Tucson, Arizona	300	550,000	351,600	+57%	1,050,000 (+91%)	Tucson
Colorado Springs	137	310,000	239,000	+30%	550,000 (+80%)	Colorado Springs
Jacksonville, FL	512	571,000	528,000	+ 8%	in preparation	Jacksonville
Albuquerque, N.M.	203	418,000	297,000	+41%	750,000 (+79%)	Albuquerque
Akron, Ohio	260	515,700	542,700	- 5.2%	in preparation	Akron
Eugene, Oregon	81	185,000	139,000	+33%		Eugene Springfield
Lehigh Valley, PA	130	382,000	363,500	+ 5%	0-.5%/year	Allentown Bethlehem Easton
Nashville, Tenn.	363	468,000	448,800	+ 5%	491,000 (+10%) (1995)	
Beaumont-Port Arthur, Texas	281	339,000	314,700 (1963)	+ 8%	423,000 (+25%)	Beaumont Port Arthur

relatively low density, automobile oriented areas as well. These patterns make it difficult to develop interest in ridesharing.

Four of the areas (Jacksonville, Colorado Springs, Tucson and Albuquerque) had one or more large military bases within their urban areas. Some of these areas have worked with the bases in setting up ridesharing programs. This can be very effective in that these bases tend to concentrate large vehicle trips in manners conducive to ridesharing. The same is true to a

lesser extent in areas with large university populations. Most of the areas studied had significant university populations, and this can be useful in a number of ways. First, ridesharing programs for university personnel can be set up, although scheduling difficulties reduce the overall effectiveness of this to some extent. Secondly, as some universities tend to have parking conflicts with adjacent residential neighborhoods, students are more likely to utilize mass transit. The atmosphere of a university, particularly in warm weather climates, tend to encourage walking and bicycling as travel modes. Eugene, Oregon has an extensive bicycle system, and is utilized heavily by university students and employees.

Figure 4
Major University Facilities in Study Areas

Area	University
Eugene, Oregon	University of Oregon
Beaumont, Texas	Lamar University
Nashville, Tennessee	Vanderbilt University
Colorado Springs, Colorado	Air Force Academy; and Colorado College
Albuquerque, New Mexico	University of New Mexico
Lehigh Valley, Pennsylvania	Lehigh University; and Lafayette University
Tucson, Arizona	University of Arizona in Tucson
Akron, Ohio	Kent State University; and University of Akron
Jacksonville, Florida	North Florida University; and Jacksonville University

Another significant use of universities in the transportation planning process is cooperation between the MPO staff and the University in the use of its facilities, particularly computer facilities. In the Lehigh Valley, the Joint Planning Commission maintains its ridesharing program at Lehigh University.

Three of the areas, Nashville, Tucson and Colorado Springs, have some degree of tourist related travel or seasonal populations, but this did not appear to be a significant factor in their orientation towards energy. However, the influence of tourist travel was one of a number of factors why areas did not put much effort into monitoring fuel consumption through state tax records regarding gas sales, as it skewed internal gasoline consumption trends.

The overall physical size of the area did not appear to play a major role in an area's approach to energy. The population parameters of the study tended to cluster the sizes of the urbanized areas around 200-300 square miles. Eugene was somewhat smaller because of its lower population and the Oregon Urban Boundary Service area limitations. The Jacksonville area has a very large urbanized area because all of the City of Jacksonville is included as urbanized, as the City has been annexing land aggressively and now claims to be physically the largest city in the United States.

Generally, all of the areas are small enough in terms of their urban areas so that average travel distances are relatively short; short enough so that gasoline consumed in commuting trips and its resultant total costs are not great enough for people to need, or be amenable to, energy efficient transportation alternatives.

2. MPO Structure and Characteristics

The nine case studies exhibited a number of different Metropolitan Planning Organization (MPO) structures. The most common arrangement is that the Council of Governments is designated as the MPO, with an Urban Area Policy Board responsible for the transportation planning process. In a majority of the cases, each city, town and county within the urbanized area is given one vote, with no weight based on population. A number of MPOs include special purpose districts such as the transit authorities, airport commissions or in the case of Albuquerque, environmental and school distists. Voting membership on the Urban Policy Boards by State transportation agencies was found in four of the areas studied. More often, State and Federal transportation agencies are included as ex-officio, non-voting members.

The most unusual MPO characteristic was found in the Beaumont-Port Arthur area, which in addition to 18 municipalities and three county representatives, also included as voting members all eight of the area's State representatives and senators.

The composition of the MPO appears to have very little to do with an area's ability to analyze and/or promote energy conservation. In no case was there evidence that the initiation of energy related networks came directly from the MPO Policy Body. The contrary was indicated in two instances. In the Tucson area, a work activity which was proposed by the staff to investigate energy impact assessment methodologies and to collect data and monitor a number of energy consumption indicators was postponed by the Policy Board on the grounds that it was too expensive and not timely, given staffing and budget limitations. In the Eugene area, an energy conservation plan which indicated policies and strategies that need to be publicly adopted in order to reduce overall energy consumption was questioned by the Policy Board as to the appropriateness for such an activity to be undertaken by a MPO.

Staff support to the MPOs is provided in a number of ways as well. Although the State Department of Transportation or Highway Department provides a considerable amount of support in most areas, particulary smaller ones, primary staff administration and technical support is usually conducted at the areawide level. In those instances where the MPO is a subgrouping of a Council of Governments, the COG transportation staff provides the major support. The Regional Planning Commission or the County Planning Commission provides staff in two other cases. In Jacksonville (Jacksonville Planning Board), Nashville-Davidson County (Metro Planning Commission), and Akron, the staff support is provided by a city agency.

Figure 5 MPO Staff Characteristics

Location of MPO Staff

	Regional Planning Commission	Council of Governments	County Planning Commission	City Agency	City/ County Agency
Tucson		x			
Colorado Springs		x			
Jacksonville				x	
Albuquerque		x			
Akron				x	
Eugene		x			
Lehigh Valley	x				
Nashville					x
Beaumont-Port Arthur	x				

MPO Support Agency Transportation Planning Staff

Area	Agency	Number of Full-Time Employees
Tucson	Arizona DOT/Pima Association of Governments	11
Colorado Springs	Pikes Peak Area Council of Governments	2
Jacksonville	Jacksonville Planning Department	6
Albuquerque	Middle Rio Grande Council of Governments	5
Akron	Akron Metropolitan Area Transportation Study	10
Lane County	Lane Council of Governments	3
Lehigh Valley	Joint County Planning Commission	4
Nashville	Metropolitan Planning Commission	4
Beaumont-Port Arthur	South East Texas Regional Planning Commission	1

The size and capabilities of the staff support are quite different among these mid-sized MPOs, somewhat but not totally correlated to population and budget. In the Beaumont-Port Arthur, Texas area, the Regional Planning Commission employs only one person as a full-time transportation planning coordinator, and either passes the remainder of the MPO planning funds to the traffic and planning departments of Beaumont and Port Arthur, or utilizes outside consultants to provide technical expertise. At the other extreme is Tucson, where the 11 person MPO staff are in fact employees of the Arizona Department of Transportation, even though they report partially to the Pima Council of Governments.

The differences in staff size relate most directly to energy conservation activities through each staff's capabilities and staff resources committed to 1) traffic modelling; and 2) data collection and monitoring. Agencies with larger staffs tend to be better able to collect information regarding indicators of energy use and input this into their models to determine future energy scenarios or to determine energy future consumption estimates. Those that cannot afford to do so or have inadequate staff to do so can only rely on more general assumptions, default values and simpler methodologies, if they can look at these impacts at all.

3. Transportation Network Characteristics

The nine case study areas exhibited a fairly similar set of roadway network characteristics and problem areas. The mid-sized areas studied generally were characterized by a roadway network made up of fairly dispersed travel patterns, with decreasing percentages of the daily travel trips oriented towards the area's central business district. Unlike larger metropolitan areas, the system leading into and out of the CBD during peak hours does not experience severe traffic congestion, and even where this problem arises in mid-sized areas, it tends to be of a fairly short duration and concentrated on only a limited number of approaches.

The rapidly growing areas are somewhat different than the more stable areas in that there is a concern about additional roadway capacity. In the Colorado Springs area, for example, the travel estimates for the year 2000 indicate that over 50% of the existing roadway network would experience severe traffic congestion by that time unless substantial additions to the system were made. The Albuquerque area, as another example, projects severe congestion in its "uptown" retail/commercial area that will require arterial expansions of up to 11 lanes.

Although the travel patterns are fairly dispersed across most of the urbanized areas, the average trip distances and travel times for work related trips remains relatively short compared to larger urbanized areas. Average travel distances in the case studies did not exceed 9 miles, and in areas such as Eugene and Lehigh Valley were less than 5 miles. Similarly, average travel times were generally in the 10-15 minute range. Even in those ares where some peak hour congestion is experienced, these congestion periods are usually dissipated within 15 to 20 minutes.

The only area which still exhibited a strong CBD orientation to its travel patterns, particularly work trips, was the Nashville area. Although this area was therefore more similar to larger urban areas, its traffic congestion problems were still relatively minor. A series of six Interstates now ring the CBD, so that through traffic does not now travel through or near the CBD. The result has been that CBD ADT has decreased in recent years, even though CBD employment has increased. Certain corridors leading into the CBD experience a short peak hour congestion problem, but overall travel times in the area still average only about 20 minutes.

Figure 6
Area Traffic Characteristics

Area	1980 DVMT	DVMT Growth	Work Trip Auto Occupancy	Average Travel Time	Average Travel Distance
Tucson	8,000,000	4%	1.2	17	6.4-7
Colorado Springs	4,200,000	5%	1.15	N/A	6-7
Jacksonville	8,000,000	2%	N/A	N/A	5-6
Albuquerque	7,000,000	1%	1.2	N/A	N/A
Akron	13,000,000	1.5%	1.26	15	8.9
Eugene	2,000,000	N/A	N/A	12-14	4.25
Lehigh Valley	5,500,000	N/A	1.2	15	4-5
Nashville	8,600,000	0-3%	1.3	15-20	N/A
Beaumont-Port Arthur	5,750,000	1.9	N/A	10	4.3

(N/A - information not available)

Although VMT in the area covered varied from 2,000,000 (Eugene) to 13,000,000 (Akron SMSA), these absolute levels were not as significant indicators of traffic congestion as the rate of VMT growth. Rapidly growing areas are experiencing annual VMT increases of 4-5%, while in most other areas the annual increase was generally in the vicinity of 2% or less.

One of the areas of similarity concerned downtown parking policies. In most of the CBD areas, there was neither a lack of convenient long-term parking available nor a significant daily charge for all day parking. Jacksonville, for example, the largest area studied, charges an average of $1.30 to park all day downtown. In Nashville, an area with a growing CBD, new parking facilities are available or are being constructed adjacent to the area's office centers, and charge a maximum of $2.00. Facilities somewhat less convenient (a 2-3 block walk) still charge only $1.00. Attempts by the MPO transportation staffs to have cities look at increased CBD parking pricing as a disincentive to energy inefficient travel have met with poor results in most areas, and existing parking rates and availability, combined with light or non-existent congestion problems, make higher occupancy vehicle or transit use programs extremely difficult to pursue successfully.

A few areas have attempted to alter their downtown parking polices to some extent. In downtown Eugene, the City has embarked on a major parking construction program for the CBD, aimed primarily at encouraging short-term shopping trips in the CBD, and employee ridesharing and transit use. The most convenient surface lots and garages are free for short-term parkers. Downtown employees park in designated facilities and are charged at a monthly rate of $26.00, or approximately $1.30 per day. Those vehicles that carry multiple passengers are provided spaces at reduced rates. The program appears to be working out fairly well, although there has been criticism by the business community about difficulty in employee parking. The City Council attempted to increase the monthly rates recently, but retracted the proposal in light of heavy public opposition. Business groups have intimated that this policy would drive business out of the CBD, but this has been difficult to document.

In Colorado Springs, the new office development in the CBD does not by statute have to provide additional parking. This has created somewhat of a parking capacity problem in the downtown area, but there is little evidence that this has led to an increase in transit or ridesharing usage.

All of the case study areas have viable public transit systems. These range in size from a fairly new 8 vehicle system in Port Arthur, Texas to a 151 vehicle fleet in Tucson. Generally, most of the transit systems, either citywide or areawide, experienced fairly consistent ridership increases during the 1970s when service was either initiated or greatly expanded, new vehicles were put into operation, and funds were available for capital improvements such as shelters, signs, downtown transit centers, etc. Fares were generally stable throughout this period of time. Although the percentage of overall trip making via transit tended to cluster between 2% and 3%, many of the areas's Comprehensive Plans looked at long-term improvements to the existing transit systems at substantial capital costs as a method to increase the percentage of trips made by transit, and thus reduce the extent of roadway improvement needs, as well as having air quality and energy benefits. Most systems experienced an increase in ridership during and immediately after the 1973 and 1979 gasoline crises, further enhancing the belief that increased transit service would generate additional non-captive ridership as gas prices continued to rise.

A number of events and observations in the past few years has seriously diminished the optimism in future transit use trends in the mid-sized areas. First, the initial increase in ridership due to the 1979 gas crisis in most cases dropped back substantially once supplies were normalized, indicating that

FIGURE 7

Traffic Network Problems

Area	Highway Congestion Into CBD	Selected Corridor Congestion Into CBD	Commercial Employment Center Congestion Outside CBD	River Crossing Congestion	Poor Intersection/ Signal Synchronization Along Arterials	Selected Arterial Congestion (Areawide)	CBD Intersection Problems	Through Traffic Corridors	Future Growth Related Problems Anticipated
Tucson		x				x			x
Colorado Springs			x		x				x
Jacksonsville		x		x	x	x			
Albuquerque			x	x					x
Akron		x			x	x			
Eugene		x							
Lehigh Valley						x		x	
Nashville	x				x		x		
Beaumont/Port Arthur							x		

gasoline availability was a much greater factor in mode choice behavior than was gasoline cost, at least for the non-captive riders. Secondly, operational costs, primarily due to rising fuel costs and to a lesser extent labor contract increases, generated substantially larger operating deficits. This resulted in fare increases which in almost all cases led to a decline in ridership. In Eugene, for example, an increase from 35¢ to 60¢ resulted in an immediate loss of one-third of total daily riders, and the system was forced to reduce the fare to 50¢.

A further problem is the Administration's proposal to reduce and eventually eliminate Federal operating subsidies. Without these funds, all of these systems will have to substantially curtail or eliminate expansion plans, raise fares to what may be prohibitive levels, or cut back existing service levels. Under any of these likely scenarios, expecting transit to increase or even maintain its current share of total daily trips is unlikely, and the potential of transit usage as an energy conservation technique is substantially reduced.

Even under existing conditions, the use of transit in these mid-sized areas is extremely limited. Given the dispersed activity patterns of these areas, it is difficult for fixed route systems to serve most travel corridors efficiently. Colorado Springs estimates that its transit routes serve 10% of daily work trip areas. Furthermore, given short work distance and travel times, express bus service, which usually is an efficient type of service, has a limited market in many of these areas. Radial systems oriented towards downtowns are still the norm in most areas, even though as a traffic generator the downtown is showing a decrease in vitality. Yet low densities prohibit more appropriate circumferential service from being efficient. In Albuquerque, where ridership has been increasing, a radial system has recently been converted to a grid system. The Tucson MPO estimates that by making significant expansions and improvements to the system by the year 2000, the system could be capable of increasing its daily ridership to 6% of overall daily trip making.

In spite of these limited roles, a surprising number of the areas still remain committed to maintaining their transit system, if only in terms of city policies and goals. The energy contingency planning that has been done has in most cases relied heavily on an expansion of the transit system in an energy emergency, and thus has provided some support for maintaining the systems. Even in areas where ridership is low, such as Colorado Springs, the city has continued to support the system's expenses. In Eugene, the City Council has adopted as a goal for its transit system an eventual 15% share of total daily trips by transit. Although this is unrealistic, it nevertheless indicates a high

degree of city support for the system, and this makes MPO transit planning easier to undertake. Although the adjacent City of Springfield did not accept this policy, it did accept a 5% figure, which is double what the system currently accommodates.

The potential of transit usage as a viable energy conservation measure in these mid-sized areas depends, to a large degree, on funding availability. With Federal funds for operating support likely to diminish over time, and competing uses for general local revenue, other alternative sources of funding are needed. In Eugene, Oregon, transit is partially funded by a 6/10 of 1% employee payroll tax. Although this has provided a funding source over and above those available to other systems, it has resulted in difficulty in planning future system expansions due to a fear by local businesses that this will result in a raising of the rate of this employer tax.

4. Technical Capability and Data Collection

The comparison of the nine case studies regarding their level of incorporating energy conservation into the transportation planning process focussed on the level of sophistication of their analytical techniques, particularly in the use of travel forecasting models, and the ability to collect various types of data, which could then be input into these models or other appropriate methodologies. These capabilities were found to be highly correlated with size of in-house staff, staff budgets, computer hardware accessibility, cooperation with State Transportation and Highway Departments and cooperation with local traffic departments.

Forecasting and Modelling Techniques

All but one of the case study areas either have a UTPS travel forecasting network model operational or are in the process of calibrating and running their models. Although the network is available in almost all of these areas, differences occur as to the in-house responsibilities of the MPO transportation staff regarding its operations and maintenance. Some of the larger areas maintain the in-house capability to run the model, have access to a main frame computer, and have programmers on their staff. In other areas, the responsibility originally rested with the State DOT, with the local agencies providing data for the model, but now the MPO is taking over total responsibility (Nashville, Eugene). In the remaining areas, the State and/or its consultants have developed the traffic network and forecasts, and run the alternative networks for the MPO.

In those areas where UTPS has already been used in the analysis of alternative transporation networks, some type of energy consumption impact has usually been included, most commonly a total daily energy consumption estimate for each of the model test networks (see Figure 8). Those areas that do not as yet have their models up and running have indicated that they will also include a similar estimate in their alternative networks.

The Tucson and Albuquerque MPO staffs have access to a mainframe computer for its data and forecasting analysis. The transportation staff in Tucson is a division of the Arizona DOT, and therefore utilizies its computer facilities. In Albuquerque, the COG transportation staff has oriented all of its data collection and analytical procedures to use of this facility. The COG estimates that a large portion of the time used on the mainframe is related to COG data and analytical work.

FIGURE 8

Energy Considerations in UTPS Travel Forecasts

Area	Estimate Energy Consumption Impacts of Each Network Alternative	Reduced Future Per Capita Trip Making Based on Energy Costs	Assure Increased Auto Occupancy Based on Energy Costs	Look at Alternative Travel Based on Energy Costs	Include High Density, Energy Efficient Network Alternative
Tucson		x	x		
Colorado Springs	x				x
Jacksonville	x				
Albuquerque	x				
Akron	x				
Eugene	Anticipated				
Nashville	Anticipated				
Beaumont-Port Arthur				Possible	

These examples appear to be the exceptions rather than the rule. In other areas, the MPO staff must rely on use of the State computer, and access is sometimes difficult. In those areas without staff programming capabilities, data is sent to the State DOT and it is programmed by State personnel.

The use of microcomputers for sketch planning and sub-area analysis is beginning, but not as yet commonly used. Three areas have recently purchased microcomputers, but most of their use is limited to word processing or minimal data manipulation. In these areas, however, indications are that with additional familiarity with the system and additional software, these will become more important components of their analytical capabilities, particularly in assessng TSM type programs. A number of other areas suggested that they were considering the purchase of microcomputers, but were having some difficulty because 1) the technology was changing so rapidly; and more importantly 2) a perceived reluctance on the part of FHWA or UMTA officials to allow computer hardware purchases as direct transportation planning project costs*.

A second major area where technical capacity has been important is in the transportation/air quality planning process. In most cases, Mobile I or Mobile II was used to assess the air quality problem and possible control measures. Those areas which were strongest in systems planning capability ran their own models and assessed TCMs in-house. Other areas utilized consultant services for their analysis. These analyses, whether conducted in-house or by a consultant, usually resulted in an output that either could be made to include energy impacts, or could be done so manually based on the DVMT reduction associated with the control measure under consideration. Four of the MPOs calculated the energy impacts of their air quality control strategies.

A third area of computer assisted technical work dealt with ridesharing programs. Most areas had computer assisted programs,set up through a variety of computer sources such as a University or a city based system. These programs sometimes included transit data as well as origin-destination travel trips, although this was discontinued in the Lehigh Valley because of the expense in trying to keep the route and schedule information updated and the relatively low "pay back" from this aspect of the system.

---

*Both FHWA and UMTA currently may allow the purchase of microcomputers for transportation planning as a direct or indirect project allowance. For more information, FHWA field staff should be consulted.

FIGURE 9

Modelling Capability

Area	Microcomputer In-House	Main Frame Availability	UTPS	Model Development Responsibility	Ridesharing Program	Air Quality Program Modelling	Transit Models	Other
Tucson	x	State DOT	x	In-house	PAG	Use University hardware		
Colorado Springs	x	County-Dec.10	x	State DOT	City Library	Consultant	Existing Statistics	User Analysis
Jacksonville	No	No	x	State DOT	x	Consultant		
Albuquerque	x	City IBM	x	In-house	University	x	Transit Patronage Model	UPTIS TRANSURV
Akron		City	x	State DOT	x	State DOT	Sketch Planning	
Eugene	No	State DOT	x	Beginning in-house forecasting State DOT	x	x		Attempting to input bicycle mode into UTPS
Lehigh Valley	No	No	No	--	University	Consultant		Trying to utilize "Transyt 7" developed by Consultant
Nashville	No	State DOT	x	Beginning in-house formerly State DOT	State	x		
Beaumont/Port Arthur	No	No	x	State and Consultant		No		

Surveillance and Data Collection

As indicated in Figure 10, most of the MPOs collect and monitor similar roadway and transit performance measures and use indicators. It is the level of detail of the program associated within each of these categories that exhibit significant differences. The agency which is the most heavily systems oriented, the Albuquerque COG, exhibits the most extensive data base in almost all of these categories. Their capability to collect and utilize transportation data is enhanced by their computer capabilities, such as the UTPIS (Urban Transportation Planning Information System), which acts as a large storage and manipulation system for collecting and maintaining a large quantity and variety of demographics, land use and transportation related data fields. In addition, they are able to directly access, manipulate and analyze records from the State motor vehicle department regarding the area's vehicle fleet characteristics, auto ownership, etc., where other areas must breakdown Statewide totals or use Statewide averages. Most areas utilized Statewide averages on vehicle fleet composition for their air quality data needs.

A number of areas estimate fuel consumption within the area by analyzing auto ownership records, ADT, VMT, fleet characteristics and average m.p.g. ratings. This is used in order to assess changes that may occur in any of these indicators regarding air quality, energy consumption and personal driving characteristics. Interestingly, no area actually monitored fuel consumption, although some said it would be possible by analyzing the tax records of gasoline sales. The overwhelming feeling was that it would be an expensive monitoring program and that its ultimate use would be neglible, as these records would not differentiate between local traffic, through traffic, tourist traffic, etc. and would not tend to be significantly different from Statewide totals, which are easily made available and utilized on a more qualitative basis. Fuel consumption in all of these areas has been decreasing on a statewide basis, even in rapidly growing states.

In some areas, the surveillance activities are undertaken in relation to a particular project in congested areas rather than through a systematic monitoring program. This is a more reasonable approach in areas such as Beaumont/Port Arthur or Colorado Springs where the entire staff consists of only one or two people. In these areas, reliance is placed on the State and/or local jurisdictions to provide monitoring and data, and extensive programs are much more difficult to have implemented. This presents some problems when areawide trends are needed, but they could be very useful in assessing and analyzing TSM type programs.

FIGURE 10

Surveillance Activities

Area	VMT Estimates	Vehicle Occupancy	Travel Time Vehicle Speed	Transit Data	Road and Street Information	Automobile Ownership	Fuel Consumption Estimates	Fuel Consumption Monitoring	Vehicle Fleet Characteristics
Tucson	---	x	x	x	x	x	---	---	---
Colorado Springs	State	x	x	x	x	x	---	---	---
Jacksonville	---	On Bridges	---	x	x	x	---	---	---
Albuquerque	x	x	x	x	x	x	x	---	x
Akron	x	x	x	x	x	x	x	---	
Eugene	x	x	x	x	---		---	---	---
Lehigh Valley	x	x	x	x	x	x	---	---	---
Nashville	x	x	x	x	x		---	---	---
Beaumont/Port Arthur	State	Some	Some	Individual Transit Authorities	---	x	---	---	---

Very few of the areas have done any significant monitoring of implemented programs. "Before and after" monitoring has been done on a limited basis, usually confined to level of service calculations. The Tucson area is beginning a program to monitor TSM performance, initially on ridesharing and transit measures. These monitoring programs can be useful in determining how accurate existing TSM methodologies are, particularly dealing with air quality or energy conservation. Many of these methodologies utilize (either by design or because of the lack of available local data) default values, and the accuracy of these results still remain largely unproven.

A number of the areas indicated that the staffs would like to initiate a much more extensive surveillance program, including energy consumption indicators, but that it has been difficult to allocate substantial funds for such efforts. These difficulties have in some cases come from the MPO Policy Board, who felt that there were more pressing needs at the time and that these surveillance activities do not have high priority given the current availability of fuel and limited overall resources. In these instances, the program has either been eliminated or postponed.

B. Overall Energy Considerations

In most of these mid-sized MPOs, the issue of energy consumption and conservation has been raised to a small degree by local public officials and area residents, with a relatively low degree of intensity. Furthermore, in those areas where future conservation is seen as a necessary goal, there appears to be more interest in residential energy use than transportation related energy, even though the transportation sector has been documented in a number of these areas as being a more significant user of petroleum supplies.

1. Impact of Recent Energy Shortages

In the recent past, two events have occurred which have served to bring to public attention the relationship between travel characteristics and the consumption of energy. The first was the Arab oil embargo of 1973, when gasoline prices were increased dramatically for the first time, highway speeds were reduced to 55 MPH, the fuel efficiency of automobiles became a major purchase consideration of new vehicles, and the need to reduce overall consumption became both an economic and patriotic concern.

The second event was the gasoline shortage of the summer of 1979, when availability became more of a concern than price, and great media attention was given to the supply problems in major metropolitan areas. The high energy consciousness caused by the 1973 embargo had been tempered a great deal by 1979. The 1979 shortage appeared to trigger in many areas a renewed interest in the public's part on fuel efficient driving and trip making, ridesharing and transit use; it also triggered a burst of activity by planners to take advantage of this interest on the public's part.

The mid-sized areas studied did not, however, experience serious impacts during the 1979 energy shortage. In only one instance was the area seriously impacted, and even there it appeared more a function of the media attention paid to the problem in nearby major metropolitan areas. Gasoline availabilty was not generally a problem, nor was there "panic buying" to any significant degree. The major impact appeared to be very limited versions of what was experienced in the larger areas: gas lines; some limited alteration in service station operating hours (shorter days; less weekend service) and some increases in transit usage and ridesharing, but no major effects.

FIGURE 11

Impacts of 1979 Energy Shortage

Area	Serious Impact	No Serious Impact	Some Gas Lines	Station Closings/ Shortened Hours	Change In VMT	Increased Transit Ridesharing	Increased Ridesharing Interest	Increased Interest in Energy Conservation
Tucson		x	minor	some	x	slight	slight	slight
Colorado Springs		x			x	x	x	
Jacksonville		was less significant than 1973						
Albuquerque		x		x	x	x		x
Akron		x				x	x	
Eugene		very serious in 1973				slight 1979 high 1973	slight	did so in 1973
Lehigh Valley	x		x	x	x	x	x	x
Nashville		x	x	some	x	x		x
Beaumont/Port Arthur		x						

It appears that the 1973 embargo and its initial price surge had more impact on personal driving habits. People who were greatly affected tended to purchase more fuel efficient automobiles after 1973. By 1979, a significant percentage of the population had more fuel efficient vehicles than they had before 1973. Since travel distances tend to be short in these mid-sized areas, the need for frequent gas fill-ups or the increase in per gallon cost were not perceived in 1979 as important enough issues to result in dramatic behavior changes, as they might have been in 1973.

In spite of this, most areas did experience increases in transit ridership, (usually slight), and either decreases or slowed rates of VMT growth. Although not as obvious, it appears that the increased public attention to energy conservation did nevertheless result in some, if not dramatic, travel behavior changes.

These impacts may not have been permanent, however. Transit ridership generally has fallen off since the crisis situation has passed and VMT is increasing once again. The interest in ridesharing, particularly employer based, is dropping rapidly. In the Lehigh Valley, for example, 12 companies had instituted ridesharing programs in 1979, with estimates of ridesharing activity within each company ranging from 25-45% of the employees. One year later, only 1 company program remained. The drop in transit ridership in many areas had as much to do with fare increases and service cutbacks, but these were treated much more elastically than had energy supplies still been perceived as shrinking.

2. Local Efforts

The areas that appear to have institutionalized energy conservation into the local governmental process appear to be the faster growing areas in the southwest. In Albuquerque, the City has formed the Albuquerque Energy Conservation Council, made up of representatives of City and County officials and agency representatives. It has been charged with developing policies for inclusion into the city and county Comprehensive Plan for reducing overall energy use within the area. The city has an Energy Office, and has been very active in promoting passive solar energy, analyzing alternative fuel for fleet vehicles, weatherization programs, etc. as well as public actions to improve transportation related energy efficiency.

The Mayor of Tucson has appointed a Metropolitan Energy Committee, a blue ribbon panel designed to coordinate energy saving activities. The group has acted primarily as a public education and information forum, running energy fairs and the like. The Committee, as well as a city appointed Energy Coordinator, worked with the Pima Association of Governments (PAG) on the area's energy contingency planning effort. A similar effort at running energy fairs and exhibits and showcases energy efficient transportation has been set up in the Colorado Springs area.

While these efforts indicate an "energy consciousness", they have not resulted in more energy efficient travel in any of these areas. In most of the warmer weather areas, non-transportation energy tends to be electrical and recent electricity rates have increased radically, spurring interest in energy conservation that has equally or topped that of colder weather areas. This interest is usually greater than that related to transportation energy.

The overall level of interest in further transportation energy conservation by the general public in these mid-sized area also appears rather low. In "environmentally" oriented areas such as Eugene, there is some interest in transit use, bicycle use, etc. as an environmental and energy conservation issue, but not in most other areas. In some areas where air quality is a concern, such as Colorado Springs, alternative transportation measures can be discussed based on their air quality implications, with reduced energy use a secondary or "extra" benefit. Most of the areas do have policies, goals and objectives in their Transportation and Comprehensive Plans, but few of these have resulted in actual implementation activities which support these policies. This is particularly true regarding energy efficient land use patterns, such as reducing sprawl, increasing densities and "activity center" approaches.

FIGURE 12

Local Energy Conservation Support

Area	Local Energy Office/ Commission	Support Increased Transit Use	Support Energy Efficient Land Use Patterns	Support Increased Density	Analyze Municipal Fleet Conversions	General Policies To Increase Energy Efficiency
Tucson	x		policy only	policy only		x
Colorado Springs	x	x				x
Albuquerque	x	x			x	x
Jacksonville	x				x	x
Akron		x				x
Eugene		x	x	x		x
Lehigh Valley	x	x	x	x		
Nashville						x
Beaumont/Port Arthur						

It is generally recognized that changes in current land use practices would do more in terms of energy consumption than other measures, but these changes have not been seen in most of these areas.

In terms of transportation related energy activities, most areas have complied with the requirements to prepare an energy contingency plan, but little public interest in these plans has been generated. Local jurisdictions have been supporting their transit system, in the face of increased costs and in some instances declining ridership. The City of Eugene has attempted to encourage increased ridership on its transit system by increasing parking fees downtown, in the face of public opposition, but like most of the other areas, it is still fairly easy and inexpensive to drive to the downtown areas in a single occupancy vehicle. In many of the other areas, particularly the older areas, the relationship between such things as land use policies and energy consumption is still not recognized in day to day decision making.

In those areas where the MPO has exhibited some degree of interest in incorporating energy concerns into the transportation planning process, the impetus has come from the MPO staff, in combination with FHWA guidance and to a limited degree State directives.

3. Standard Energy Related Activities

All of the areas studied have participated in a number of activities through their transportation planning processes that relate directly to energy considerations. The two standard examples are promotion and/or operation of ridesharing programs, and energy contingency planning. Both activities emerged primarily out of the 1979 (some ridesharing efforts began in 1973) gasoline shortage and the resulting Federal policy directives and guidance in these areas. While a number of areas have undertaken additional activities related to energy, ridesharing and contingency planning are considered for the purpose of this study to represent "base line" energy related efforts.

a. Ridesharing

In all of the areas studied, a ridesharing program was operational, and meeting with varied degrees of success. Almost all of the area's programs were either initiated or experienced a surge in interest in 1979. In one area, the program had been initially set up during the 1973 embargo, was discontinued in the mid-70's due to a reduction in interest, and re-initiated in 1979. In most cases, the carpool program is operated out of either the MPO staff office, the transit authority or a joint effort of the two. Two areas utilize computer resources of nearby Universities, and one program operates out of the local library's computer system.

Most of the programs initially started out as individual matching programs, utilizing grid-based origin and destination locational systems. While there was substantial interest during periods of energy shortages, over time the interest waned, and the cost effectiveness of many of the programs also declined. Many of the programs are now concentrating on employer based programs, which have proven to be much more effective in the long run. These have been combined in some areas with vanpool programs. In a number of areas, the State's DOT, energy office, or environmental agency also provides assistance in ridesharing programs.

The success of these programs is somewhat difficult to measure in most areas. Information is available through journey to work data, vehicle occupancy monitoring, and survey work regarding the percent of commuters who belong to any type of ridesharing program. In most areas, this percentage usually falls within the 15-20% range, although not all of this represent former single occupancy vehicle drivers who now leave their vehicles home on certain days, but include people who do not

drive or who formerly used transit. Some of the ridesharing programs include or have included in the past transit information, so that an interested party could be given the nearest route and schedule for a transit trip that would take that party to his destination. The ability to keep this information updated within the program has proven to be very expensive, and it was generally felt that the number of people who actually used this information was too small to justify its continuation.

The general feeling was that ridesharing programs are a good, low cost method to reduce VMT, as every carpool formed results in immediate energy consumption reductions. However, it has proven to be difficult to achieve a significant number of actual carpool formations in many areas, and the amount of energy conserved based on the total number of carpools formed is much lower than many other techniques. Those areas that have, or are just now, concentrating most of their efforts on employer based programs, are finding this to be a more effective ridesharing promotion activity. The employer based programs tend to be much more actively supported by employees and usually result in more permanent carpool and vanpool formations.

Increased reliance on ridesharing has been used as an air quality transportation control measure in almost all of the areas that are non-attainment areas. Because of this use, the potential impacts on VMT reductions have been analyzed, in order to determine total emissions reductions. A number of areas have also estimated the number of gallons of fuel that would be saved as well. These analyses generally assumed a substantial future increase in the number of daily work trip commuters who were participating in carpools, based on increases in energy costs, increased traffic, etc. In the Albuquerque area, for example, it was assumed that the present estimate of 8.5% of work trips made in carpools would increase to 20% by 1987.

This resulted in a daily VMT reduction of 425,000 miles, a daily gas consumption savings of 28,500 gallons, and a yearly savings of 6.13 million gallons of gasoline. This represents 1.6% of total energy consumption in the county.

The analysis done for vanpooling indicated a much lower impact (.14%). Employer based programs, however, indicated a much higher energy "payoff" of 4.6% of total energy consumption.

Similar efforts were done in Lehigh Valley indicating the same magnitude of difference. The high level of interest in employer based ridesharing after 1979 led to the formation of 12 company programs. Annual fuel savings were estimated to be over 332,000 gallons per year. Areawide ridesharing's potential in

the area, however, is at best estimated to be only about 50,000 gallons of fuel saved. Of the 12 employer based programs formed after 1979, only one is still in existence, and no new programs have been initiated.

The Tucson area has undertaken similar efforts in its ridesharing program and also suggested as a short range goal an areawide ridesharing percentage of 20% of total traffic, which it estimated would result in an annual savings of 6.7 million gallons. Tucson has gone one step further, however, and included ridesharing in its long range program, designed to reduce the number of new roadway miles necessary to meet demand. Tucson has estimated that a strong publicly supported program to ridesharing (including HOV lanes, park 'n rides, etc.) which resulted in a doubling of commuter ridesharing to 40% in the year 2000, would be an extremely cost effective method of reducing total new roadway facilities needed by 200 lane miles. This is estimated at a cost of $20,000,000.

Other areas have suggested more modest fuel savings based upon increased ridesharing. Associated improvements and encouragements to ridesharing such as park and ride lots were also commonly provided on a generally small scale, as their usefulness in these sized areas has not proven to be substantial. Short travel times and distances and lack of serious congestion in most travel corridors have limited the potential of some one getting into their car, driving to a park 'n ride, and then either carpooling or taking an express bus. These facilities have been used most effectively in the study areas for certain long distance commuters (e.g. Colorado Springs to Denver) or in conjunction with express bus service along a congested corridor (e.g. Nashville). Nevertheless, State Highway Departments generally appear to be receptive to build these facilities if given MPO support, and generally this support has been forthcoming. In the Beaumont-Port Arthur area, for example, the State is willing to construct 12 park and ride facilities, even though the demand for such facilities has not been demonstrated. It is generally believed that if facilities were made available, they are likely to become utilized in time, and they would be immediately available in the event of an energy emergency.

b. <u>**Energy Contingency Planning**</u>

All of the areas studied had prepared emergency energy contingency plans following the guidance of FHWA and UMTA in their March 29, 1979 joint memorandum directing MPOs in urban areas to develop an energy contingency plan as part of their annual unified work program. The plans were generally prepared by the primary MPO transportation staff agency; in one instance, it was prepared by the transit authority, and in one case was

developed by an outside consultant under contract to the MPO staff organization.

The contingency plans were fairly similar in nature, as well as in their recommendations. About half of the areas followed the guidance to indicate different levels of energy supply shortages, and indicated different levels of actions that need to be undertaken given the difference in severity (see Figure 13). Other areas provided a discussion of measures in terms of their priorities, with an indication that more severe shortages would result in the addition of lower priority measures. Still other areas differentiated between voluntary actions and mandatory actions, with mandatory actions only being put into effect during more serious supply interruptions.

The strategies analyzed fell into four basic categories:

1) strategies to reduce daily travel demand and fuel consumption.

2) strategies to manage fuel supplies and distribution.

3) strategies to encourage more efficient travel.

4) public information and awareness strategies.

In most of these mid-sized areas, the general strategies recommended leaned heavily towards increased roles of the transit system and ridesharing programs to assist in moving residents from their homes to their work places. The overall sizes of the area made it seem possible that given resources to expand both systems, this could satisfy a great deal of the area's work related travel demand. In areas such as Akron, with a large DVMT and limited transit systems, this proved to be a less feasible strategy.

A second major recommendation cited in most areas was the need to set up an ongoing energy coordinating council composed of local energy coordinators, businesses, service stations, the MPO and the transit district, in order to monitor supply situations and work to insure that the proper mechanisms are in place.

Recommended as ultimate measures to be instituted primarily under severe shortage conditions were fuel allocation programs and more radical "travel behavior shifts" (e.g. 4-day work weeks). These mandatory programs were generally felt not to be necessary under less severe scenarios.

FIGURE 13

Energy Contingency Plan
Major Recommended Strategies

Area	Set Up Central Energy Coordinating Council	Public Information	Expanded Ridesharing Program	Expanded Transit Service	Fuel Allocation Strategies	Expanded Public Storage Capacity	Various Depending On Different Shortage Scenario
Tucson	x	x	x		x		x
Colorado Springs			x	x	x	x	
Albuquerque	x	x	x	x	x		
Akron		x	x	x			x
Lehigh Valley	x	x		x		x	
Nashville		x	x	x			x
Beaumont/Port Arthur	x		x		x		x

Most areas also recommended increases in the fuel storage capacity of municipalities, counties, the transit district, utilities and other emergency fleet vehicles.

While most areas believed that energy contingency planning was an important and appropriate work program activity for the MPO, there was a general belief that its implementation is only likely to be successful when strong energy conservation measures are already in place, which could be expanded in the event of serious emergency situations. Furthermore, it was believed that the contingency planning program tends to imply that measures to reduce gasoline consumption need not be put into effect until an "emergency" situation arises. If energy conservation measures are encouraged throughout the normal functioning of the transportation system, than the severity of a shortage can be alleviated.

Most of the MPOs have thus concentrated on conservation strategies such as increased transit usage, express buses and park and ride, expanded ridesharing programs, etc. as their major travel behavior contingency measures, rather than more involuntary travel restrictions or disincentives. The threat of another shortage, whether perceived or not by the general public, and the mandate from UMTA to develop an energy contingency plan, has enabled MPO staffs to look at a number of these conservation as well as contingency measures.

4. Transportation Improvement Program

The Transportation Improvement Program (TIP) prepared annually by the Metropolitan Planning Organization in the study areas in most cases did not include energy consumption impacts as one of the criterion for project inclusion and prioritization. A number of factors and characteristics of the TIP process combine to make this the rule rather than the exception.

The TIP process in most areas is a highly political process. Although significant analytical and technical work may have been conducted in order to determine a transportation improvement project's likely traffic impacts, environmental impacts, and overall costs, the final decision as to whether it is included on the TIP and its relation to other projects often include less tangible factors. How this is determined is different in each area, but all areas concede that the particular needs and wishes of public officials and their interaction play a considerably important role in the ultimate determination.

Because of this similar characteristic of most TIP processes, technical reasons which can elevate or lower a project's status and priority must be strong, or have direct funding/implementation implications. At the present time, a project's impact on energy consumption, whether positive or benefit, is not a "strong" enough reason to be usually considered in the decision making process.

The second reason why the TIPs have remained relatively free of energy concerns is the fact that few of the areas have appropriate methods of adequately assessing a project's energy consumption impacts. Although beginning to become available, particularly regarding TSM type projects, existing methodologies are still somewhat basic and in many instances based on broad assumptions and default values. To advocate a project based on such limited methodologies in light of general lack of interest in its use as a criterion would indicate a lack of political acumen.

In addition to these problems, other concerns come to light when attempting to assess projects which do not result in changes in travel behavior. One MPO pointed out the difficulty in assessing energy impacts of many transportation improvements because so many variables are involved.

In two of the areas studied, energy impacts have been included to some extent in the TIP process. The Jacksonville

area TIP had until this year a category in its TIP called "Air Quality, Year 2000 Plan, Energy Conservation". This category attempted to indicate the effect that each project had on air quality in the area, on the recommended Transportation Plan network, and on energy consumption. Each project's impacts were listed as either none, minor or significant.

This category was dropped in the FY'82 TIP and the staff is currently analyzing methods to improve this criterion for upcoming years. The system had a number of flaws. First, it grouped all three criteria into one classification, so that it was impossible to tell which of the three criteria was impacted, although there was an assumption that all three were complementary. Secondly, it was not a quantitative analysis, and there were no standards as to what constituted minor and significant impacts. Further, it did not indicate whether the impact was positive or negative.

Although the system was broad based and not an indication of technical analysis, it nevertheless came under criticism by EPA because projects were not necessarily prioritized on its basis. The Jacksonville TIP contains a category assigning a MPO priority to each project, with 1A having the highest priority, 1B a somewhat lower priority, 2 lower than either of the first two, and 3 indicating a low priority. EPA's concern was that certain projects indicated as "signficant" in the category which included air quality did not necessarily receive a high priority ranking. They apparenty believed that this made the TIP process inconsistent with their air quality program. As a result, this criterion was dropped, although the Jacksonville MPO hopes to reintroduce energy as a criterion once it has developed appropriate quantitative analytical tools.

The Albuquerque area has also introduced an energy consumption element into its TIP process, and is presently studying methods to improve its ability to list quantitatively energy impacts. The Albuquerque COG has, as an adjunct to its energy conservation and contingency programs, developed a series of energy conservation measures or ECMs as they are called. These have been developed for their possible inclusion into an energy conservation plan, similar to the air quality planning process with transportation control measures or TCMs. It is anticipated that selected ECMs, after evaluation as to their energy savings potential and their implementation feasibility, will be programmed into the TIP as funding permits.

At the present time, however, the COG has been utilizing its air quality technical work as a basis for identifying possible ECMs. In the existing TIP, those measures which are listed because of their impacts on traffic flow and air quality

which appear to be potential ECMs, (that is, having likely conservation benefits), are indicated by a "ECM" in the box before the project's description. This indicates that based on existing information and analysis regarding the project, it is likely that the project is a potential energy conservation measure. The COG staff is now in the process of quantifying the impacts of these ECMs.

The COG staff will, at the present time, conduct a quantitative energy impact analysis of a potential transportation improvement project when a number of conditions are met: 1)If they are asked to do so, or energy impacts are likely to be seriously considered by decision makers; 2)when an appropriate methodology exists to adequately determine energy impacts; and 3) if qualitative assessment indicates that the impact is likely to be significant, in either direction. If these conditions are met, energy impact analyses will be conducted.

5. Transportation Systems Management; Air Quality

This section discusses the efforts that are ongoing regarding both transportation system management strategies and air quality planning, as the strategies forwarded in each tend to overlap to some degree. All of the areas under study have incorporated into their transportation planning process strong Transportation System Management (TSM) components, consistently with Federal guidelines and directives during the late seventies. All but one of the case study areas also are nonattainment areas for particular air quality standards and have thus developed an air quality/ transportation planning program. These programs have resulted in the recommendation of a number of air quality "transportation control measures (TCMs)", and in most instances these TCMs provide the basis and/or a substantial portion of an area's TSM or short-term plan.

The TSM strategies that have been advanced in most of these areas are grouped into three general categories:

1) strategies designed to improve the traffic flow and efficiency of existing roadway facilities;

2) strategies designed to reduce overall vehicle use;

3) strategies designed to encourage the use of public transit.

Generally, the mid-sized MPOs tend to recommend similar types of measures as being appropriate and cost effective for their regions. Given traffic patterns, individual travel characteristics, locations of employment areas and the dispersal of residential growth apparent in most of the areas, traffic flow improvement strategies are seen as the most beneficial TSM type of strategy. These improvements, such as traffic signal synchronization, arterial improvements (paving, safety, etc.) and problem intersection improvements, are all designed to improve travel speeds and reduce points of delay, thus resulting in lessened traffic congestion and reduced vehicle emissions and improved energy efficiencies as well.

Strategies designed to reduce vehicles use, such as increased reliance on carpooling, vanpooling, bicycle usage and encouragement of these alternative modes via accessory strategies of HOV lanes, park and ride lots, and parking policies, is also generally encouraged in the areas, although the cost effectiveness is generally viewed as less impressive than the flow improvements.

Strategies designed to improve the local transit system and thus encourage additional ridership are also generally supported,

FIGURE 14

Transportation System Management Strategies

Area	Traffic Flow Signal Synch.	Arterial Intersection Improvements	Reversible Lanes	Carpool	HOV	Park and Ride Express Bus	Transit Expansion	Bus	Staggered Work Hours Parking	Parking Policies	Fleet Conversion	Bicycles	Pedestrian Malls
Tucson		x	x	x		x	x		x			x	
Colorado Springs	x	x		x			x		x				
Jacksonville	x	x		x	x	x	x	x	x	x		x	x
Albuquerque	x					x	x		x	x	x		x
Akron	x	x		x		x			x				
Eugene	x	x								x		x	
Lehigh Valley	x	x		x		x	x		x				
Nashville	x	x	x	x	Possible	x	x	x	x			x	x
Beaumont/Port Arthur													

although the overall level of potential benefits are somewhat lesser still, and the costs required to make such improvements often does not provide a particularly attractive cost-benefit ratio.

These transportation system management measures are attractive for a number of reasons. They generally are of a much lower magnitude of cost in relation to construction of new roadway capacity, they can generally be implemented fairly quickly, they have much fewer negative environmental and social impacts, and they generally result in improvements to air quality. In addition, it is believed that they have beneficial impacts on overall energy consumption, although as a rule these impacts are not quantified. For the most part, it is assumed that those TSM measures that are beneficial to air quality are also beneficial in reducing energy consumption and/or improving energy efficiency. TSM strategies are usually assessed as to their potential use in an area or in a particular sub-area based on a number of different criteria, some quantifiable not depending upon the criteria, the data available and the analytical capacity of the MPO staff. Figure 15 illustrates as an example the performance criteria used in the Tucson area to assess potential TSM actions, and the performance measures that are used to assess these impacts. The Tucson 1981 Short Range Transportation Plan indicates that

> *"the standards should be achieveable and, as much as possible, quantifiable. However, there are situations where no such standards are available, making qualitative assessment the only analysis technique"*. (*page* 32).

The Tucson area, a rapidly growing area, utilizes the results of such TSM performance evaluations, partially quantitative and partially qualitative, to determine if the TSM strategy can be designed to reduce or postpone the need for major roadway improvements that will otherwise be necessary. Analysis indicates that strong public support for five TSM measures could result in an overall reduction of new roadway improvements by 35% in the year 2000.

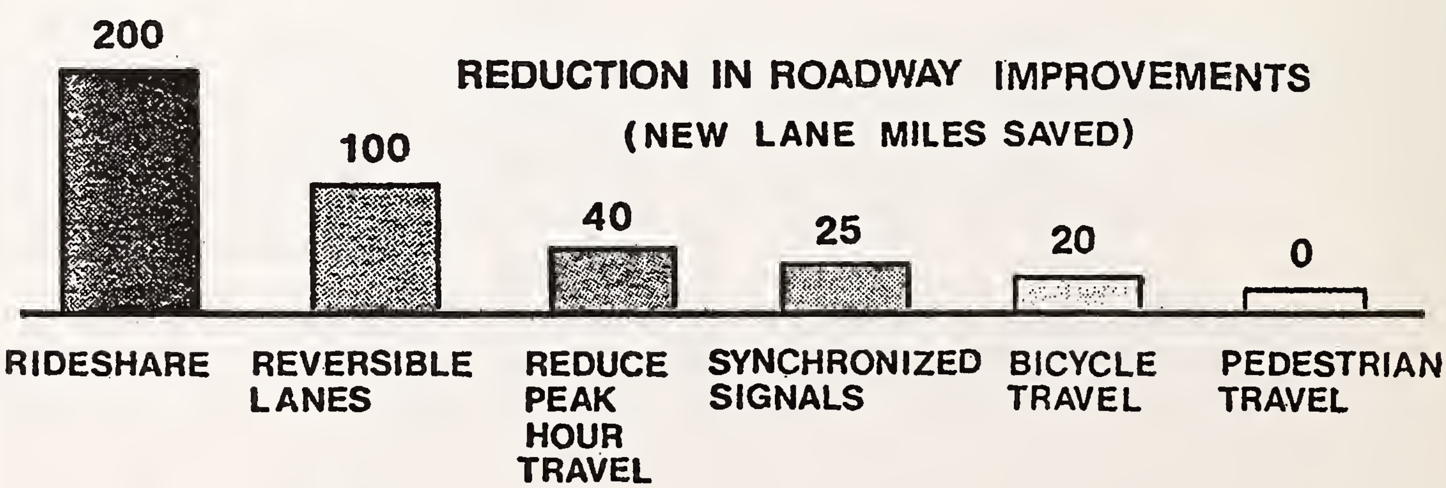


Figure 15

Tucson TSM Evaluation Criteria

PERFORMANCE CRITERIA	PERFORMANCE MEASURES
1. Travel time	Point to point travel time Person hours of travel Vehicle delay Vehicle hours of travel
2. Travel costs	Point to point out-of-pocket auto costs. Parking costs Point to point transit fares
3 Safety	Accident rates Fatality rates
4 Comfort and convenience	Travel delay Schedule adherence Variance of average point to point travel Perception of system performance
5. Auto Usage	Intersection vehicle turning movements Person trips Traffic volumes Vehicle miles of travel
6. Transit Usage	Transit patronage
7. Bicycle usage	Bicycle counts
8. Pedestrian usage	Pedestrian counts
9. Capacity	Volume/Capacity ratio Level of service
10. Capital/Operating costs	Per unit costs
11. Noise	Noise level scale
12. Air quality	Carbon monoxide emissions Total suspended particulate counts Ozone measurements
13. Energy	Fuel Consumption data National energy standards Standards from specialized research
14. Socio-economic	Population Transportation disadvantaged Employment Commercial activity Number of displacements/relocations
15. Auto occupancy	Auto occupancy counts

Source: PAG, Short Range Transportation Plan, 1981

Although ridesharing would have the greatest impact, a major expansion of the program, at a total cost of $20,000,000 is deemed necessary, and the number of carpoolers must double to 40% of total peak period trips in order to achieve this effect. The total costs associated with the five TSM measures is as follows:

TSM Measure	Total Cost
Rideshare	20,000,000
Reversible Lanes	4,000,000
Reduced Peak Hour Travel	10,000,000
Synchronized Signals	4,000,000
Bicycle Travel	6,000,000

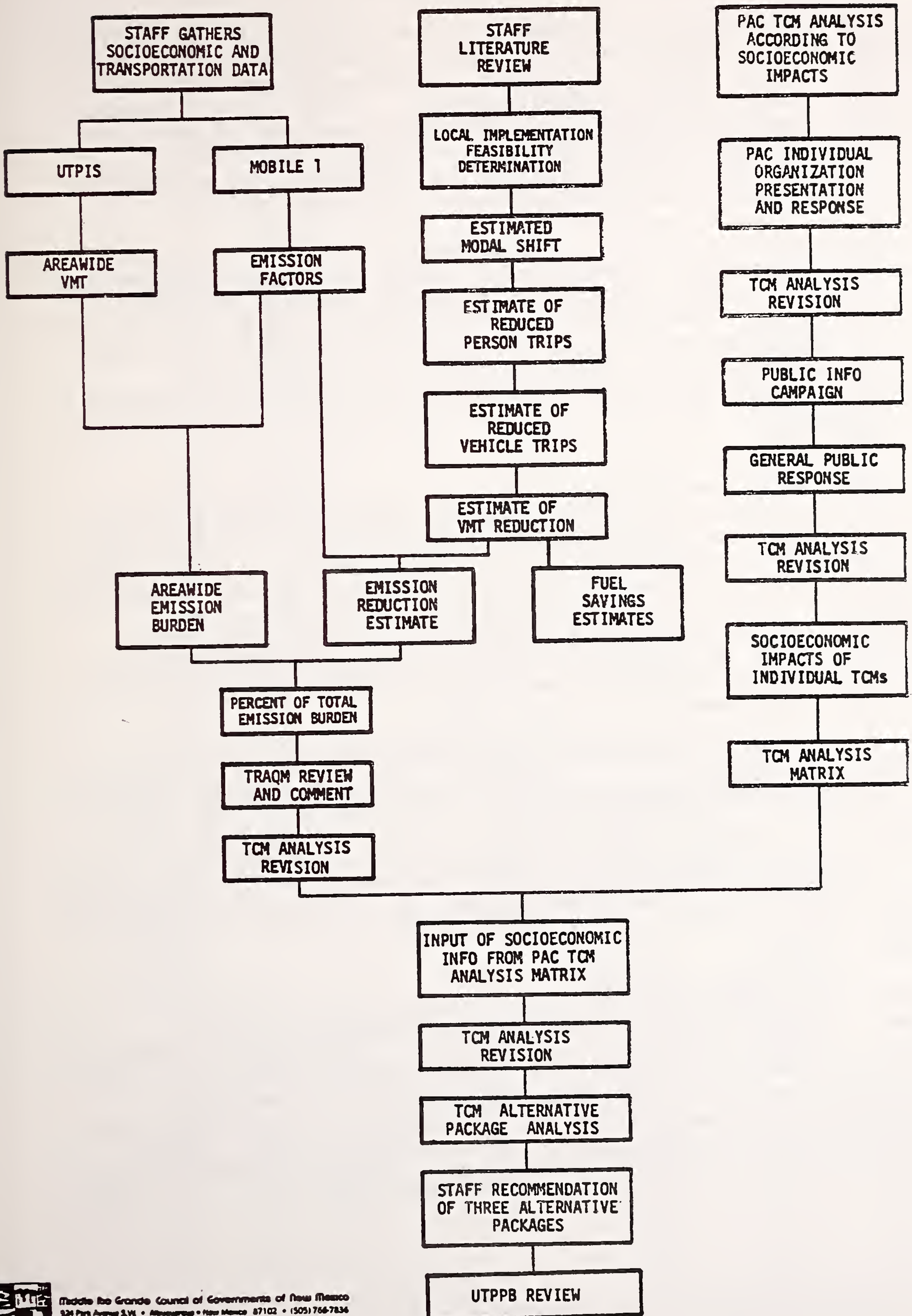
Energy impact analyses generally fall into the "non-quantifiable" category, although indications are that this is changing to some degree; only three of the areas studied provided any energy impacts in their TSM or TCM strategy assessments and analyses (Jacksonville, Albuquerque and Lehigh Valley). In all of these cases, the energy impact analysis was conducted on those strategies being assessed under the requirements of the air quality transportation program. These air quality programs, and the analytical techniques developed and used within these programs, have proven to be the biggest single reason why energy impacts of TSM strategies are now beginning to be included in MPO assessments. Other areas have attempted to suggest qualitatively the energy impacts of particular TSM measures, either by +/- systems; "significant, insignificant", etc., but other than assessing the gallons of energy saved by various ridesharing programs, no technical work has been undertaken.

The energy impact analyses that are being conducted as an outgrowth of the air quality TCM analyses are most easily computed in those strategies which clearly result in VMT reductions. By dividing these daily or annual VMT reductions by an average vehicle miles per gallon figure, the daily or annual savings in gallons of gasoline consumed can quickly be determined. Less easy but still quantifiable are traffic flow improvements that result in improved average operating speeds rather than VMT reductions. In these instances, some determination of improved fuel efficiency resulting from a change in particular speeds is needed. Once such an assumption is made, then the overall change in gasoline consumption can be subsequently computed.

The Albuquerque area has included an energy impact component in its analysis of transportation control measures. Figure 16

TCM Analysis System Flowchart

Figure 16



illustrates the technical process utilized by the COG in their evaluation. Note that the fuel savings estimates are calculated as a direct result of the estimation of VMT reduction for each particular transportation control measure. This process results in a fairly simple calculation to determine gallons of gasoline saved, and since the COG has already estimated countrywide gasoline consumption, it is possible to determine the percentage reductions in overall energy that such a strategy suggests.

Figure 17A is a summary of the energy consumption impacts of the various potential transportation control measures analyzed as part of the air quality program. The numbers point out that (of those quantitatively analyzed), employer based ridesharing is the greatest energy conserving measure, short of conversion of fleet vehicles to propane fuel. Each of the other measures, by themselves, result in a rather small areawide savings, although a number of measures in conjunction with one another often provide greater savings.

The Albuquerque analysis was based on its ability to calculate an estimate of overall county gasoline consumption in 1987, as well as its evaluation of VMT reductions. It did not, however, attempt to determine the energy impacts of traffic flow improvements, which do not result in a decrease in VMT and may in fact result in a VMT increase due to improved roadway performance. The COG staff believed that it did not at the present time have an acceptable methodology which would provide accurate estimates; thus it chose not to perform an energy analysis of these measures at this time.

The Lehigh Valley MPO provided energy impacts of its air quality control measures, in a similar manner to that provided in Albuquerque, and also provides a non-quantifiable energy impact assessment of its other TSM measures. Figure 18 is a matrix prepared by the Joint Planning Commission staff summarizing the impacts of various TSM measures under consideration for inclusion into its Transporation Improvement Program. This matrix includes a category which indicates its potential in promoting energy efficient travel.

The Lehigh Valley air quality program also included an assessment of the energy consumption improvements of its potential transportation control measures. Figure 17B summarizes the potential energy savings of a number of these TCMs. In the Lehigh Valley area, most of these benefits are relatively insignificant. The methodologies utilized are basically the same as that utilized in Albuquerque, as indicated by this simple explanation of the park and ride energy consumption methodology:

Figure 17
Energy Impacts of TSM Measures

a. Albuquerque Area

TSM	1987 Estimated Annual Fuel Consumption Savings (gals)	Percentage of Total County Fuel Consumption
- Signal Synchronization	No estimate	
- On-Street Parking Controls	No estimate	
- Alternate Work Schedules	1,052,971	0.45%
- Transit Service Improvements	1,893,412	0.81%
- Park and Ride Lots/Express Transit	175,000-287,000	0.07-0.1%
- 2¢ Local Gasoline Tax	486,735	0.54%
- Areawide Carpooling	3,675,855	1.6%
- Vanpooling	322,322	0.14%
- Employer Based Ridesharing	10,873,674	4.6%
- HOV Lanes	233,786	0.1%
- Pedestrian Improvements	No estimate	
- Bicycle Facilities	10,431	0.39%
- Fleet Conversions to Propane Fuel	20,214,286	8.6%
- Controls on Vehicle Idling	No estimate	
- Vapor Recovery	351,764	0.15%

Source: Middle Rio Grande Council of Governments of New Mexico, Evaluation of Transportation Control Measures, July, 1981

b. Lehigh Valley Area

TCM	1987 Estimated Annual Fuel Consumption Savings (gals)	Percentage of Total County Fuel Consumption
- Park and Ride Lots	240,700	0.1%
- Transit Fleet Expansion	400,000-600,000	0.2-0.3%
- Evening and Weekend Transit Service	18,000	negligible
- Transit Service Area Expansion	30,000	0.0125%
- Areawide Ridesharing	50,000	0.02%
- Employer Based Ridesharing	81,000	0.03%
- Subscription Bus Services	26,800	0.015%
- Smaller Buses	46,700	0.02%
- Alternative Work Schedules	172,000	0.07%

"The use of gasoline is computed by dividing the change in vehicle miles traveled by the average car mileage (assumed to be 15 mpg) which has been used in ridesharing calculations and multiplied by the number of work days per year (assumed to be 200)".

Source: Technical Paper #1, page 63

Directions on estimating the energy implications of traffic flow improvements have also been provided to Pennsylvania MPOs from the Pennsylvania Department of Transportation under its Energy Conservation Congestion Reduction and Safety (ECONS) program. This methodology is based upon differing fuel efficiencies at different speeds, and fuel consumption impacts of fairly simple improvements can be easily determined manually by estimating or monitoring travel (see page 82 for a fuller description of the ECONS program).

Generally speaking, any technical analysis which can assist in determining changes in VMT and/or travel speeds resulting from a TSM or TCM strategy can serve as a basis for assessing energy consumption impacts. Strategies which are more complex in their operations and those where results may not be easily estimated or monitored are more problematic to assess in terms of energy. Methodolgies to do so are either not available in the study areas or are currently being assessed as to their possible use.

Although energy impacts are being conducted to some degree via the air quality planning process, in most other areas TSM analyses do not include energy consumption quantitative components. Neither are TSM type measures being proposed or recommended <u>because</u> of their energy conservation impacts. TSM improvements are supported strongly when they can be shown to act as a low or lower cost method of reducing congestion problems. The fact that strategies which increased travel speeds and/or reduce total number of vehicles on a roadway facility may <u>also</u> save energy only strengthens the initial support for a project (if mentioned at all), but does not as yet constitute a major criterion for decision makers.

An attempt to increase the significance of energy impacts of TSM projects in the decision making process is being initiated in the Albuquerque area. Currently, Albuquerque's energy impact analyses rely on fairly simple methodologies based primarily on VMT reductions. It has not as yet developed internally or accessed from other sources a methodology that provides a more detailed assessment of energy impacts or analyses on more complex projects. The COG has developed a series of what it calls energy

Figure 18

PROJECT – OBJECTIVE MATRIX

OBJECTIVE / PROJECT	Safe: Reduce Travel Accidents	Safe: Remove Model Conflicts	Safe: Eliminate Confusion	Balanced and Coordinated: Increase Use of Transit	Balanced and Coordinated: Balance Capacity and Demand	Balanced and Coordinated: Reduce Peak Hour Demands	Balanced and Coordinated: Provide Alternatives to 1 Occupant Car	Reliable, Comfortable and Convenient: Distribute Adequate Level of Service	Reliable, Comfortable and Convenient: Establish Smooth Transfers	Reliable, Comfortable and Convenient: Emphasize Maintenance	Reliable, Comfortable and Convenient: Minimize Congestion	Accessible: Improve Access to Major Facilities	Accessible: Serve Elderly and Handicapped	Accessible: Provide Accessibility for Non-Ambulatory	Accessible: Provide for Efficient Goods Movement	Environmentally Compatible: Reduce Hydrocarbon Emissions	Environmentally Compatible: Reduce Environmental Conflicts	Environmentally Compatible: Divert Non-Beneficial Through Traffic	Economical and Efficient: Maximize Use of Existing Facilities	Economical and Efficient: Efficient Use of Public Funds	Economical and Efficient: Encourage Private Participation	Economical and Efficient: Promote Efficient Energy Use
ACTIONS TO ENSURE THE EFFICIENT USE OF EXISTING ROAD SPACE																						
Allentown TOPICS																						
o 7th St. Corridor	+							+		+	+	+			+	+			+	+		
o Union Blvd.	+	+	+					+		+	+	+			+	-0.4			+	+		
o Hanover Ave. Widening	+	+	+					+		+	+	+			+	-0.6			+	+		
o Lehigh St. Corridor								+			+	+			+	+			+	+		
Bethlehem TOPICS																						
o Broad St./378		+	+		+			+	+		+					+	+	+				
o Catasauqua Rd./378			+		+			+	+		+	+				+		+	+	+		
o River St. Access Ramp	+	+						+	+		+	+				+		+		+		
Easton TOPICS																						
o Northampton & 5,6	+							+							+				+	+		
o Washington & 4th	+							+			+								+	+		
o Cattell/Knox/Lafayette	+			+				+		+					+	+			+	+		
o Bushkill St. & Riverside	+							+		+		+				+			+	+		
o Northampton & 3rd	+				+			+		+	+				+	+			+	+		
o St. John/Old Phila./Lincoln	+		+		+			+		+	+				+	+			+	+		
o Inner Loop	+	+	+	+				+	+	+	+	+			+	+		+	+	+		
Urban TOPICS																						
o Harrison/North/Macungie																			+	+		
o Wm Penn & 25th	+										+				+	+			+	+		+
o Freemansburg & Greenwood											+				+	+			+	+		+
o Northampton & Greenwood											+				+	+			+	+		+
o Park & Heckett											+				+	+			+	+		+
o Wm. Penn & Greenwood	+														+				+	+		
o Mauch Chunk & Schadt	+										+					+			+	+		+
o MacArthur & Mickley	+										+				+	+			+	+		+
o MacArthur & Schadt	+														+				+	+		
o Friedensville/Hickory	+										+					+			+	+		+
o Race St. & Airport Rd.											+				+	+			+	+		+
3rd St. Corridor-Bethlehem		+	+		+			+		+	+	+			+	+			+	+		
Allentown Bikeways		+	+				+	+				+				+	+		+	+		+
Easton Bikeways		+	+				+	+				+				+	+		+	+		+
Schoenersville & Jacksonville		+	+		+			+		+	+	+			+	+			+	+		
191/Butztown Rd.	+		+								+	+							+	+		+
191/Oakland Rd.	+							+			+	+			+				+	+		
Market St. Extension			+					+			+					+				+		
ECONS																						
o Lehigh St.	+							+			+	+			+	+			+	+		
o Emmaus Ave.											+					-0.08			+	+		+
o Hanover Ave.																						
o E. 4th St.																						
o Airport Rd.																						
ACTIONS TO REDUCE VEHICLE USE AND IMPROVE AIR QUALITY																						
o Employer-Based Ridesharing/ Alternative Work Schedules				+	+	+	+	+			+	+				-6.61	+		+	+	+	+
o Park and Ride Lots				+		+	+		+		+					-6.85			+	+	+	+
o Signal Coordination																						
- Emmaus Ave. - 4th to 31st	LISTED WITH ECONS PROJECTS																					
- Gordon St. - Ridge to 6th											+					-0.06			+	+		+
- 5th & Union											+					-0.08			+	+		+
- 12th & Chew											+					-0.08			+	+		+
o Replace All-Way Stops (21) in Bethlehem											+					-2.10				+		+
o Remove "No Right on Red" Jefferson & Wyoming						+					+					+				+		+
ACTIONS TO IMPROVE TRANSIT SERVICE																						
Short Range Transit Program				+	+		+	+	+		+	+		+		+	+		+	+	+	+
o Routing and Scheduling			+	+	+	+	+	+			+	+		+		+	+		+	+		+
o Capital Improvements																						
- Transfer Centers				+					+					+						+		
- Energy Conservation Improvements										+									+	+		+
- Bus Replacement Program				+			+			+				+		+	+					+
Promotion of Coordinated Paratransit																						
o VAST Service - LANTA				+	+	+	+				+	+		+	+	+	+		+	+	+	+
o VAST Service - Others				+	+	+	+				+	+		+	+	+	+		+	+	+	+
o VAST Van Replacement				+	+	+	+			+		+		+	+	+	+			+	+	
o VAST Computer				+	+	+	+	+				+		+	+				+	+	+	+
Subscription Bus Service				+		+	+				+	+		+	+	-0.43			+	+	+	+
Demand-Responsive Rural Transportation																				+	+	+
Reduced Fare for Off-Peak Transit				+	+	+	+	+		+	+	+		+			+		+	+		+

NOTES: "+" denotes a positive impact on an objective.
For further definition of objectives, see earlier section of this report.
In the column "Reduce Hydrocarbon Emissions," numbers represent the change in tons/year 1981 to 1987.

Source: Joint Planning Commission Lehigh-Northampton Counties

conservation measures, or ECMs. These are TSM type projects which the COG believes to have great potential to save energy. At the present time, the use of these ECMs is limited to a notation on the TIP which indicates those projects believed to have significant energy conservation benefits, qualitatively assessed. However, over the next year, the COG expects to review those energy conservation methodologies being developed elsewhere, as well as its own system planning capabilities, to develop an internal assessment methodology which will enable them to quantitatively assess energy conservation potential, and will also assess implementation feasiblility. They will then, as funding permits, program selected high benefit ECMs onto the TIP. Although most of these ECMS should also provide traffic flow and air quality benefits, this will be an initial attempt to highlight their energy conservation benefits as a primary consideration.

6. Long Range Planning

A major work activity of all MPOs, regardless of size, is the development, adoption and maintenance of a Long Range Transportation Plan, or a Long Range Element of the Comprehensive Transportation Plan. It is in the development of the Long Range Plan that changes in energy costs and availability are likely to have the most significant effect. Vastly higher fuel costs, potential for long-term energy shortages and differences in automobile fuel efficiencies all may affect travel behavior, and this in turn will impact the need for new, improved or altered roadway and transit facilities.

On the other hand, the uncertainty about long range fuel supplies make it extremely difficult to input into a travel forecasting network any particular assumption concerning the "most likely" future energy scenario. To decide to plan for a particular future network based on one scenario is very risky, and there is unliklely to be consensus on any one such scenario within the MPO decision making structure. Furthermore, as the Plans, and the assumption behind these plans, are intended to be reviewed annually and updated periodically, there is a tendency to "wait and see", in order to get a more clearly defined sign of future energy trends. The difference, for example, of the energy future as it appeared in 1979, and the "oil glut" experienced today, is evidence that this wait and see attitude can be considered wise. Trends in auto ownership, travel patterns, gas consumption elasticities, etc. since gasoline price and supply became a public issue during the seventies, will be more fully developed and easier analyzed as time passes and data becomes available, making a further case for not attempting to pin down scenarios and travel changes based on these scenarios at the present time.

Generally speaking, there has not been a major trend within the mid-sized MPOs to attempt to factor in energy considerations in travel forecasting. But as a number of the areas have been finalizing their traffic networks and using these networks for the first time in preparing their Long Range Plans, there is some interest in "manipulating" their networks to some extent to include energy related factors. The modelling capabilities make this possible. It would be very unlikely that such possibilities would be looked at if hand calculations would have to be manually done before the impacts could be assessed.

In the areas studied, there are two major ways in which energy use and conservation are considered in the development of Long Range Plans. The more common approach is to utilize the output of UTPS to determine the overall daily fuel consumed in

FIGURE 19

Area	Estimate Energy Consumption Of Each Network Alternative	Reduced Travel Forecasts Due To Higher Energy Costs	Include High Density Energy Efficient Alternative	Include Higher Transit Use Goal	Use TSM Measures As Method To Reduce New Roadway Needs	Provided That Travel Forecasts Based On Various Energy Scenarios
	Energy Conservations In Long Range Plan					
Tucson		x		x	x	
Colorado Springs	x	x	x	x		
Jacksonville	x		x			
Albuquerque	x					
Akron	x					
Eugene	Anticipated			x		
Lehigh Valley						
Nashville	Anticipated	Anticipated				Possible
Beaumont/Port Arthur						Possible

vehicles traveled under each alternative transportation network. In these instances, travel patterns are not necessariy altered based on energy costs and availability; that is, energy is not used as an input, but rather is used as an output, based on other, non-energy related diferences in the alternative networks. Given an operational UTPS system which 1)estimates total daily VMT; 2)estimates average speeds;and 3)makes assumptions regarding average vehicle fuel efficiency in the target year, an overall energy consumption total is easily obtained. A majority of the areas studied now do this or will do so once their network model is operational.

In some of the areas, one of the alternative networks has been developed under a land use growth scenario that is particularly conducive to increased mass transit usage and therefore reduced air pollution and energy consumption. In Colorado Springs, as an example, the MPO developed an "activity center" scenario which concentrated future predicted growth into eleven specified areas, rather than spreading the growth out in a continuation of the sprawl pattern. This was done as a way to maximize potential transit usage and roadway improvement costs. Although not developed primarily as a way to conserve energy, it was assumed that a significant decrease in energy consumption would result.

The MPO modelled this as one of their three alternative future networks, along with a do-nothing and a most probable. The overall energy impacts were calculated as follows:

	Do Nothing	Most Probable	Activity Centers
Fuel Consumption (gallons per day)			
a. Private Vehicles	434,500	423,900	379,500
b. Public Transit	1,670	2,930	4,650

The activity center approach did result in approximately a 10% reduction in daily energy consumption. It also resulted in increased transit ridership. But the MPO staff was disappointed in the results; they had hoped that the activity center approach would result in more significant benefits, as it was not believed that the changes in land use, densities, etc. could be "sold" unless the overall benefit differentials were higher. This scenario was not endorsed by the MPO.

The Jacksonville Year 2005 Transportation Plan conducted a similar activity. They also developed three atlernative future travel forecasts based on somewhat different development

patterns: a low density sprawl pattern, a future growth occurring largely within the Development of Regional Impact (DRI) project areas and dispersed, satellite employment areas; and a growth corridor emanating from downtown. This "growth corridor" alternative was developed to attempt to increase the transit modal split, similar to the Colorado Springs "activity center" approach but necesitating less radical land use changes.

The network energy consumption estimates are as follows:

	Low Density	DRI Concept	Growth Corridor
Daily Fuel Used (gallons)	1,362,800 (100.0 base)	1,367,200 (100.3)	1,336,000 (98.0)

The Growth Corridor was shown to result in an overall 2% decrease in energy consumption over the other two networks, a less significant difference than the Colorado Springs area. Yet in this case, because its other impacts were seen as beneficial, and the approach was not "radically" different from existing trends, this concept was approved by the MPO as the desired future land use pattern.

In the Albuquerque area, the energy consumption difference of various study alternatives have been analyzed as well in certain cases where there is an interest in such impacts and where a significant difference among alternatives is possible. This has recently been done in a corridor study regarding additional crossing capacity over the Rio Grande. Consumption estimates were similarly based on total mileage and travel speeds. In this particular instance, the differences among alternatives was minimal, although all were more beneficial than the alternative with no additional capacity.

A second method in which energy concerns have been integrated into the Long Range Planning process in some areas is an adjustment of the basic assumptions regarding a number of the inputs that are used as base information for the travel forecasting model. Although UTPS does not include a variable designed specifically to take into account fuel price changes directly, certain other variables may be adjusted to reflect energy cost changes. These inputs include personal income, automobile ownership and household trip making, and have been adjusted in some areas based on the impacts of future energy costs.

The most systematic adjustment was conducted in the Tucson area as part of the Long Range transportation planning process, and documented in <u>Energy Adjusted Travel Demand Forecast</u>, prepared by the Transportation Planning Division of the Pima

Association of Governments. Their UTPS network was believed to need some adjustment to take into account a likely continued increase in energy costs over the forecast period (target year 2000). The TPD developed a most probable transportation energy scenario for the Tucson region, determined the impacts of this scenario on transportation costs, and then developed adjustment factors for the future travel demand forecast to reflect the higher costs of travel. Since the basic model correlates per capita vehicle trips with family income, it was assumed that higher costs of energy would be incorporated into the model by reducing the increase in family income to reflect the amount of the increase that will go directly into energy purchases and maintenance costs. The basic assumption was that by the year 2000, the cost per gallon of fuel, in terms of 1979 dollars, would be $4.42, and that the non-fuel transportation costs that must be borne by the automobile owner will increase 33% from .138/VMT to .184/VMT. These assumptions lead to a conclusion that as a percentage of average total household income, energy costs will increase from 4.5% of total income in 1979 to 10.8% in the year 2000; and that non-fuel costs will increase from 13.4% to 28%. The result, after factoring in rise in household income, is a 10% increase in the proportion of household income necessary to maintain the projected level of travel.

This 10% increase was assumed to be analogous to a 10% decrease in real household income, so the income factor of the forecasting model was thus reduced by 10%. The result was a 10.2% reduction in projected internal vehicle miles travelled in the year 2000.

In the Colorado Springs' Year 2000 Transportation Plan, the effects of increases in automobile operating costs was used to adjust yet another input into the travel forecasting model, the number of vehicles per household. For purposes of forecasting, it was assumed in this case that the cost of owning and operating an automobile will increase by 150% relative to the costs of other goods and services, after compensating for inflation by the year 2000. (This would indicate a target year per gallon fuel cost of about $3.00, or $1.42 less than that assumed in the Tucson Plan). This was estimated to reduce auto ownership to an average of 1.4 vehicles per household, similar to levels prevailing in 1970, and below the 1.9 vehicles per household that would have otherwise been assumed. Applications of trip generation equations using this figure yielded an average of 7.5 trips per household per weekday in the year 2000, rather than a rate of 8.7.*

*In the Jacksonville Plan, changes in automobile ownership based on operating costs were indirectly made, in that the 1.26 automobile ownership per household that exists today was held constant throughout the planning period, even though household incomes were projected to increase.

These revised data, simulating the effects of constraints on auto usage, were input only into the "activity center" network, and the unadjusted figures were used in the other two forecasts. Here again, this differs from the Tucson model where the energy adjustment was made to all network alternatives.

Some adjustment was also made in assumptions related to future transit usage. Ridership and farebox revenue estimates made for continuation of the existing transit system, and for an expanded grid system, reflected no change in current automobile operating costs; while estimates of potential use of a new line haul and feeder system did reflect the 150% increase in automobile operating costs discussed above, assuming that this type of system would only be viable with further automobile usage constraints.

In other areas, while energy cost adjustments were not made and energy consumption impacts not yet calculated, other energy related factors were included with the Plans. In a number of instances, a goal was adopted to increase the potential of the daily total trips that were made by transit, and thus transit expansion and/or incentives for transit usage were included in the network analysis, even if current demand and travel patterns would not otherwise have deemed this likely. In the Tucson area, the affect of expanded public support for a number of TSM measures were analyzed as to their impact on future roadway needs. These types of measures, when included not only as Transportation Plan policies, but as input to the network choices, has in fact implicitly resulted in a situation where reduced energy consumption (among other benefits) is being used as an underlying constraint to the system, and therefore is to some extent being prioritized.

7. Special Energy Conservation Activities

The preceeding sections have documented efforts in which energy conservation considerations have been incorporated into areawide transportation planning, through short and long range planning activities, air quality planning and ridesharing promotion. In addition to these "normal" MPO activities, a number of the areas studied have undertaken separate activities which, though related to and used in other work element activities, have been undertaken specifically to discuss and analyze the energy conservation considerations of transportation programs.

While these activities are not widespread, a majority of the areas did develop some type of activity in this regard, and some more than one. The activities can be broken down into four general categories:

1) separate energy conservation planning documents;
2) energy conservation/transportation policies;
3) energy/transportation issues papers;
4) areawide gasoline consumption estimations.

Figure 20
Special Energy Conservation Activities

Area	Separate Energy Conservation Planning Program	Transportation/ Energy Conservation Policy Document	Energy Transportation Discussion Paper	Areawide Energy Conservation Estimates
Tucson			x	
Albuquerque	Anticipated	x		x
Akron	x			x
Eugene	x	x		
Lehigh			x	x

This section briefly describes the activities found to have been undertaken in each of these categories of activity.

a. <u>Separate Energy Conservation Planning Documents</u>

This category includes those activities in which a separate energy conservation "document" has been prepared, rather than activities in which the energy impacts of projects pursued for other reasons are indicated. The prototype of such an effort is the air quality program. That is, a number of TSM type measures will be analyzed as to their potential energy savings. As stated earlier, the Albuquerque area has developed a number of these measures, which they call Energy Conservation Measures (ECMs). These ECMs have been assumed to have significant energy conservation benefits, and a summary table of the long-term and emergency actions necessary, and the appropriate responsible agency has been prepared for each one. Quantitative analysis of these ECMs is anticipated, but has not as yet been undertaken, pending further investigation of appropriate methodologies and analytical techniques. Once these analyses are conducted, those proven to be technically beneficial and deemed to be politically acceptable, will be moved forward for approval by the MPO Policy Board for inclusion into the TIP.

The Akron Metropolitan Area Transportation Study (AMATS) has recently prepared a document entitled <u>Energy Considerations in Transportation Planning</u>. This document serves as an overview summarizing all of the activities undertaken by the MPO that supports the conservation of energy. It discusses the manner in which energy concerns are incorporated into the short and long range planning activities in the Akron area, indicates how certain of the MPOs goals and objectives support energy conservation, and lists the type of activities that are and/or will be undertaken to continue to monitor energy consumption within the area. Its appendix lists a number of fuel consumption indicators in which AMATS has collected appropriate data.

The major part of this effort is the consideration of a list of energy conservation strategies, similar to the Albuquerque ECMs. The staff initially inventoried the list of 55 measures originally identified in the area's energy contingency planning analysis, believing that many might be appropriate for their long-term energy conservation value. In order to evaluate the potential conservation measures, a set of planning criteria was developed. These factors include:

1) time to implement;
2) effect on area trip making;
3) cost to implement;
4) impacts on highway or transit operations;
5) implementation feasibility.

Figure 21

Albuquerque MPO

Potential Energy Conservation Measures

Measures to Increase Ridesharing

- Public information and marketing ridesharing
- Carpool/Vanpool programs
- Carpool/Vanpool incentives
- Taxi service improvements

Measures to Improve Transit Service

- Public information and marketing transit
- Route and/or schedule modification
- Increase passenger carrying capabilities
- Increase transit patronage
- Improve fuel utilization
- Preferential treatment for transit

Measures to Provide Alternatives to Motor Vehicles

- Bikeways and pedways
- Land use management

Measures to Restrict Traffic

- Traffic limited zones
- Parking management

Measures to Improve Peak Hour Traffic Flow

- Street improvements
- Work hour adjustments

Measures to Restrict Energy/Fuel

- Reduce gasoline sales
- Reduce fuel consumption

Source: Middle Rio Grande Council of Government of New Mexico

Figure 22

Akron Metropolitan Area Transportation Study
Recommended Transportation Energy Conservation Actions

<u>Incentives to Use High Occupancy Vehicles</u>

- Bus/carpool only lanes (reserved lane)
- Bus/carpool only lanes (new construction)
- Permanent park and pool lots
- Ridesharing incentives
- Permanent park and ride lots

<u>Improving Total Vehicles Traffic Flow</u>

- Improved signal systems
- One-way streets
- Reversible lanes
- Eliminate on-street parking
- Eliminate unnecessary traffic controls
- Turning movement restrictions

<u>Increasing Car and Van Occupancy</u>

- Employer carpool matching programs
- Areawide carpool matching programs
- Carpool public information

<u>Increasing Transit Capacity and Patronage</u>

- Establish new routes and extend existing service
- Extend service into areas outside the existing RTA
- Crosstown bus routes
- Route schedule changes
- Subscription bus service
- Increase turnback operations
- Increase double-heading on key routes
- Revise maintenance schedules
- Reduce deadhead mileage
- Increase marketing efforts
- Public information system

<u>Encourage Walk and Bicycle Modes</u>

- Develop bikeway system

<u>Improve the Efficiency of Taxi Service</u>

- Contract with taxis, other paratransit

<u>Reducing the Need to Travel</u>

- Four day work week or staggered work hours

Source: AMATS, <u>Energy Considerations in Transportation Planning</u>, 1982

The analysis of these conservation measures did not include a quantitative analysis of their energy consumption impacts, but rather suggested the trends and the magnitude of impacts under each of the criterion used in the analysis. Summary tables listing the results of these analyses for each of the 55 measures were developed and published with the document (See Appendix B). Based on these results, a number of potential measures were dropped from consideration. These eliminated strategies included temporary measures, ineffective measures and/or measures which did not appear politically or socially feasible. Twenty-eight measures remained, and these have been recommended as appropriate energy conservation strategies for the Akron area (Figure 23).

The third effort in this category was the Transportation Energy Conservation Plan developed in 1980 by the Lane Council of Governments for the Eugene-Springfield area. This document is a cross between the activities described above and the policy documents that follow.

The Conservation Plan served a number of purposes. It explained the need to conserve energy and listed major goals and objectives that transportation and energy policies should address:

Goals

- *Reduce per capita fuel consumption for transportation uses in the metropolitan area.*

- *Maximize motor fuel conservation while maintaining an acceptable level of mobility for area residents.*

- *Minimize the adverse effects of the long-term transition from "cheap" motor fuels to transportation fueled by more expensive energy resources.*

Objectives

- *Stimulate intergovernmental discussion regarding transportation energy conservation.*

- *Develop, monitor and refine consistent areawide policies that foster motor fuel and transportation energy conservation.*

It then listed the four types of actions that result in reduced energy consumption:

1) *Reduction in per vehicle consumption through improvements to the vehicle or vehicle operating conditions;*

2) *Reduction in per capita travel;*

3) *Lane use and zoning to reduce the need for travel; and*

4) *Shifts to more energy efficient modes of travel, such as carpooling, transit and bicycles.*

The Plan then indicated (from national sources) the likely effectiveness of various public actions that could be taken to reduce energy usage:

Conservation Strategy	*Area Fuel Savings (%)*
Improved Vehicle Mileage	15.0-30.0
Bus Actuated Signals	0-0.5
Improved Signal Systems	1.0-4.0
Carpool Matching Programs	3.0-6.0
Increased Parking Costs	0.5-3.0
Fuel Tax	2.0-6.0
Four Day Work Week	1.0-6.0
Zoning	1.0-10.0

Based on the above, the Plan suggested that local conservation efforts should proceed on these broad fronts:

1) *a general upgrading of alternatives to the low occupancy automobile;*

2) *a general upgrading of operating conditions for the automobile, along with simultaneous application of selected disincentives;*

3) *land use and zoning decisions that reduce the need for travel.*

The bulk of the Plan is the recommendation and detailed discussion of a number of specific policies that need to be adopted at the local level which would result in energy benefits. The policies proposed relate to a number of transportation systems efforts such as increased ridesharing promotion, more park and ride lots, increased support for transit, bicycle

facilities, parking disincentives, etc. However, it also includes a number of broader transportation related measures, such as suggesting a local gasoline tax and promoting Federal decontrol of petroleum prices. Further, a number of the proposed policies relate to changes in land use, densities and spacial configuration, and public improvements are also included and discussed in terms of their impact on transportation related energy usage. Twenty-four such policies were advanced (see Appendix B).

The document was an attempt by the MPO staff to develop long-term policies which deal comprehensively with energy conservation on an ongoing basis. It was not a technical analysis of various techniques, although their impacts were assessed qualitatively and by utilizing research done by others.

Although strongly supported at a staff level, the MPO Policy Committee was not enthusiastic about its development and adoption. Some members believed that such a wide ranging effort was not appropriate for the COG to undertake.

b. Energy Conservation Policies

All of the areas have officially adopted goals and objectives which direct their various transportation planning activities. Most include the conservation of energy as a specific goal, or discuss the need for more energy efficient travel networks. These tend to be fairly general in nature and act with others to support TSM types of transportation programs.

Although the MPOs support energy conservation as a goal, only a small number have attempted to develop specific policies which relate directly to the conservation of energy. Since energy use in the transportation section is dependent upon a wide range of variables, including those outside the traditional purview of transportation planning, these efforts need to discuss a variety of subject areas.

The Energy Conservation Plan discussed above is the most comprehensive effort found in the course of this study to develop a set of specific energy conservation policies. These policies were developed specifically for the goal of conserving energy, although they support other transportation goals and objectives as well. The Plan also contains another section not discussed above. The MPO staff analyzed the policies proposed within the COG's Comprehensive Plan, in order to determine those policies (non-transportation) that are consistent with and would encourage energy conservation within the transportation section. This is an attempt to further merge transportation planning with other areawide planning and development activities in advancing overall energy efficiency. This effort, as discussed previously, was not met with enthusiasm by the MPO Policy Board, partially because it did "cross over" traditional transportation planning boundaries.

A similar effort, but with a different procedural process, was developed in Albuquerque. Rather than having a "transportation" agency develop policies which relate to other activities as well as transportation, the Albuquerque area developed a series of policies relating to conservation of all types of energy, and included transportation policies as a portion of their overall program. The Albuquerque Energy Conservation Council analyzed a large number of potential areas where energy conservation would be possible, and developed a series of city/county policies which would be adopted as amendments to the Comprehensive Plan. These policies dealt with the conservation of energy within buildings, encouragement of renewable energy system development and usage, transportation and street lighting, energy emergencies, and energy information and coordination. The document specified a number of specific policies relating to each area, estimated total potential energy savings (in BTU's) and listed a number of possible implementation techniques designed to support the policies.

In the section dealing with "Transportation and Street Lighting", the following policy was recommended:

Policy: *Promote and Encourage*:

1) *Land use patterns which reduce the need to travel.*

2) *The safe and easy access to practical walking and bicycling routes.*

3) *The development and expansion of multi-modal and paratransit systems.*

4) *The use of railways.*

5) *Traffic flow improvements.*

6) *Minimum performance standards for automobiles.*

7) *The conversion of street lights to the most efficient lighting source for the area whenever possible.*

Performance Expectation: 10% (15.1 *Billion BTUs*)

Source: Albuquerque Energy Conservation Council, Energy Policies Action Program,1981

The document then lists a number of possible techniques that need to be considered in order to achieve the performance expectation. These techniques are summarized in Figure 23.

While these policies have not been prepared by the MPO, input from the COG was utilized and those policies and techniques forwarded are consistent with those advocated by the MPO staff in Albuquerque.

c. Energy/Transportation Issues Papers

In addition to TSM energy impact analysis, conservation plans, and policy documents, another activity found to be undertaken by certain MPOs has been the development of short "issues" or "discussion" papers that discuss the area's dependence upon petroleum fuels, the likelihood of supply and/or cost problems in the future and the need to reduce this dependency, the methods available to do so, and implications to the area's transportation planning process. The purpose of these activities vary, but generally are used to stimulate discussion, to keep energy concerns in the public's attention, and to provide a perspective in which to understand some of the transportation management alternatives under consideration.

The areas that have developed these papers are Tucson and the Lehigh Valley. In Tucson, a background paper was prepared for a Community Energy Planning Conference that was conducted by the Metropolitan Energy Committee. This paper discussed the modal split in the area, the cost of automobile travel, the trends in these directions over the next twenty years, and outlined its basic assumption about an energy future. It's two primary assumptions are that 1) except for occasional interruptions, fuel will be available; and 2) that deregulation will result in a year 2005 cost of fuel (in 1979 dollars) of $4.50 per gallon.

The paper then discusses the major problems in the area regarding these energy factors. Among the most significant was believed to be the vulnerability of the fuel delivery system, given the dependence upon foreign oil. Other factors discussed as particularly troublesome to the region were the degree of dependency upon petroleum inherent in the area's transportation system (more than 90%), and the fact that prevailing land use patterns tend to reinforce reliance on the private automobile.

The paper also discusses the inefficiency of the area's travel patterns. The major portion of trips in the Tucson area are those connecting many different origin points with many different destination points, in a relatively dispersed travel pattern. The lack of areas of "mixed use" development and lack

Figure 23

* = Accomplished or being developed by Government

Primary Characteristics of Possible Techniques Summary Table

POSSIBLE TECHNIQUES	PURPOSE: Conservation	PURPOSE: Renewables	PURPOSE: Health & Safety	PURPOSE: Information	END USE IMPACTS: Residential	END USE IMPACTS: Commercial	END USE IMPACTS: Industrial	END USE IMPACTS: Transportation	END USE IMPACTS: Government	TYPE OF CONSERVATION: Electricity	TYPE OF CONSERVATION: Natural Gas	TYPE OF CONSERVATION: Petroleum	POSSIBLE IMPLEMENTATION METHOD: Local Government Leadership	POSSIBLE IMPLEMENTATION METHOD: Local Community Leadership	POSSIBLE IMPLEMENTATION METHOD: Encouragement/ Incentives	POSSIBLE IMPLEMENTATION METHOD: Demonstration/ Development	POSSIBLE IMPLEMENTATION METHOD: Reduce Institutional Barriers	POSSIBLE IMPLEMENTATION METHOD: Planning/ Regulation
TRANSPORTATION AND STREET LIGHTING																		
Promote Ridesharing	X							X				X	*	*	X			
Loans for Vanpools	X							X				X	X	X	X			
Licensing of Jitney Transport	X							X				X	X				X	X
Continue Auto Performance Standards	X							X				X	*					
Continue to Develop and Expand Mass Transit	X							X				X	*					*
Encourage Development of Alternative Transportation Fuels	X							X				X	*		X	*		
Implement Vehicle Emissions Inspection & Maintenance Program	X							X				X	*					X
Install Telecommunications System For Government Use	X								X			X	X					
Vehicle Fleet Management	X								X			X	*					X
Raise Minimum Driving Age Requirements	X							X				X	*					
Waste Oil Recycling for use in Street Paving Materials	X							X	X			X	X					
Automated Fuel Dispensing Controls	X							X				X	*					*

Source: Albuquerque Energy Conservation Council, Energy Policies Action Program, 1981

of consideration given to bicycle and pedestrian movement further constrains the potential of greater energy efficiency. Plans and policies for the future are likely to follow these patterns.

In addition, the paper concludes that perhaps the most wasteful aspect of urban travel is the stop and go traffic that is prevalent within congested intersections. Estimates done in the region suggest that relatively low cost measures designed to smooth the flow of traffic through these areas can result in fuel savings of between 15 and 50%*.

The paper then emphasizes the importance of an active Energy Contingency Planning effort, and further suggests the need for "evolutionary" changes to the transportation and land development systems. It concludes by suggesting a number of questions to focus on:

trip making - *how much room is there for stabilizing or reducing the average number of trips per person? How might it be done? By whom?*

trip lengths - *what factors can be manipulated through conscious and rational decision making which will result in reduced average trip lengths? How can they be carried out? By whom?*

mode choice - *what steps can reasonably be taken to encourage and facilitate ridesharing, transit, bicycling and walking? How can they be carried out? By whom?*

fuel efficiency - *what things can be done at the local level to increase fuel efficiency? How can they be carried out? By whom?* (*page* 6)

---

*"Transportation Background Paper for the Community Energy Planning Conference", PAG Transportation Planning Division, page 4-5.

The Lehigh Valley effort, The Potential for Efficient Use of Gasoline in Passenger Transportation (February, 1982) was similar to the Tucson effort in its scope, as it also described the existing problem, potential types of solutions, and implications for the Lehigh Valley. The body of the paper discusses five generic types of programs which will reduce dependence on petroleum fuels, and analyzes their potential effectiveness in the area:

1) voluntary gasoline use reductions (e.g. ridesharing, transit)

2) induced gasoline use reductions (e.g. gas taxes, high parking)

3) forced gasoline use reductions (e.g. rationing, odd-even)

4) more fuel efficient cars (e.g. higher national standards)

5) alternative fuels (e.g. alcohol based, electric).

The paper then suggests a most probable energy scenario in the Lehigh Valley (page 6-7):

1. *There will be occasional short-term disruptions between the gasoline supply and demand. The occurrence of such disruptions cannot be controlled within the Lehigh Valley.*

2. *Residents and workers will react during future disruptions with increased use of carpooling and public transportation.*

3. *After gasoline supplies return, most people will abandon their more efficient "crisis" mode of transportation in favor of the convenience of private automobiles. This change may take place gradually, and higher gasoline price levels may induce relatively few people to maintain their more efficient mode. Most people, however, will adjust to higher price levels and maintain private auto use.*

4. *The most effective methods of achieving gasoline efficiency will be developments in automotive engineering and alternative fuels. These methods do not rely on people reducing their trip making.*

5. *No policy changes will occur in the Lehigh Valley which would provide strong auto use disincentives.*

The paper concludes by explaining some of the implications of this energy scenario in the Lehigh Valley's transportation planning process. These can be summarized as follows:

1. The automobile will continue to be the dominant travel mode in the Lehigh Valley in the foreseeable future. Therefore, the need to maintain the existing highway network and plan for its future is obvious.

2. Some increases in the use of public transportation is likely; however, large investments in upgrading and expanding the system is not warranted.

3. Transportation planning programs should actively promote ridesharing alternatives, and have adequate capacity to handle increased technical assistance in this area. Energy conservation approaches should also be included in any corridor or sub-area studies that are undertaken. However, there is no reason to adjust the assumptions that were made regarding future travel characteristics because of the gasoline situation.

d. <u>Areawide Energy Consumption Estimates</u>

Another activity which has been undertaken (and alluded to in earlier sections) is an estimate of current and future areawide vehicle fuel consumption within the transportation planning area. Some areas have considered developing their estimates based on an analysis of tax records from State agencies regarding fuel sales. Most have concluded that such data is too expensive to collect and not necessarily a sound measure of internal fuel consumption. In other instances, this data is not available. Therefore most estimates are used based on VMT and assumptions concerning fuel efficiency.

The Albuquerque gas consumption estimates for Bernalillo County is used as a basis for much of their air quality/energy impact analysis. An estimate was made for each year between 1980 and 1991, using a number of assumptions:

1980 ratio/vehicle/person	1.35 vehicles per person (remains constant through 1991)
Annual VMT per vehicle	8,349
Annual VMT growth	4%
Average MPG pre-1980 vehicles	11.2% MPG
Average MPG 1980 vehicles	20 MPG
Average MPG 1984 vehicles	27 MPG
Annual fleet replacement with new vehicles	1/15 of total fleet

Sample calculations of future countywide energy consumption are included in the Appendix. 1979 documented gasoline consumption in Bernalillo County was 225,047,576 gallons. Estimates for 1991 utilizing this methodology results in a projected gasoline consumption of 241,615,418.*

Another area where fuel consumption estimates were calculated in a similar manner was Akron. Akron based its estimates on total daily vehicle miles travelled and average fuel co-efficiency. For passenger vehicles (16.86 MPG composite), and buses (4.09 MPG) 1981 daily fuel consumption in Akron was estimated to be 779,975 gallons of gasoline and 2,974 gallons of diesel fuel.**

---

*Source: Middle Rio Grande Council of Governments of New Mexico. (see Appendix B for full calculations)

**Source: AMATS, Energy Consideration in Transportation Planning, September 1982, pages 32-33.

8. State Guidance On Energy Conservation

Before the energy "crisis" of the 1970's, there appeared to have been relatively little activity on the part of State governments related to energy use in the transportation sector. The 1973 oil embargo began to change this to some extent, primarily due to reduced speed limits and stepped up enforcement actions, and the possibility of gas rationing plans. The 1979 situation further increased State activity, responding to the Federal requirements that State Energy Contingency Plans be developed and maintained. By 1980, most states had some form of State Energy Office, usually set up as either a separate State agency, a division of the Governor's office, or through the Department of Transportation.

Direction from the State to the MPOs on energy matters concentrated mainly on energy contingency planning activities, as in many instances the State Plan was a compilation of the various areawide efforts. In addition to this, a number of States began to "permit" the use of Federal Aid Urban Systems funds for ridesharing efforts, such as the construction of park and ride lots and the expense of operating computer assisted ridesharing efforts.

In the case study areas, State direction to the MPOs regarding energy conservation issues was limited as to planning activities. Funding for ridesharing and park and ride lots were a more common response. In the Beaumont/Port Arthur area, for example, the State Department of Transportation was committed to the construction of 12 park and ride lots in the area.

In some states across the country, State Transportation Departments have been active in providing guidance to metropolitan areas regarding methodologies which can be used to calculate energy impacts of projects, particularly TSM type of improvments. Original work was done by the California Department of Transportation (CALTRANS)*, and the New York State Department of Transportation** has been very active recently in

---

*California Department of Transportation, Energy and Transportation Systems, 1978

**Transportation Data and Analysis Section, New York State Department of Transportation, Energy Impacts of Transportation Systems Management Actions, 1981

developing these methodologies. The State of Kentucky***, as another example, has recently developed a user's manual for assessing energy impacts of TSM actions.

In the case study areas, a few states have developed assistance programs for their MPOs; some of which are similar to the above efforts. The Transportation Energy Efficiency Manual (TEEM) is most similar to the above programs. TEEM was developed for the Florida Governor's Energy Office by the transportation planning consulting firm that also developed the Kentucky Manual. TEEM was developed as a user's manual. It provides to local staff a set of analytical tools with which to analyze the energy impacts of transportation system management projects. These tools can be incorporated into the local agency's systematic analytical planning process.

Information was compiled on sixty-four transportation energy conservation measures, both traffic operations and VMT reduction strategies. Research then was conducted to determine the extent to which each of these measures had been used in transportation projects and evaluated for its energy conservation impact. While TEEM provides information on each of the 64 measures, only those measures where acceptable methodologies existed (i.e., Advanced Measures) were presented in detail in the Documentation Chapter. Each of the Advanced Measures was reviewed further to determine potential impacts (Figure 24) and ranked according to its effectiveness (Figure 25). The interrelationships among the categories of measures also was developed (Figure 26).

These figures highlight TEEM's strength (and its weakness). Each transportation system is unique. Each part of a system is also unique. Therefore, while relationships between broad categories of measures may be constant, any given measure can have a different effect on one system than it had on another. This makes it difficult to predict the reaction of a measure in any system. Conversely, this allows the methodologies to be applicable under widely varying circumstances.

***Transportation Cabinet, Department of Vehicle Regulation, Commonwealth of Kentucky, Energy Conservation Through Transportation Systems Management Actions - Users Manual, 1982

Figure 24

TEEM

INDEXING OF ADVANCED STATE-OF-THE-ART MEASURES

Specific Measure	Potential Energy Savings*	Level of Cost*	Level of Local Funding*	Technical Expertise Required*	Level of Population Affected*
Express Bus Service	3	3	2	3	3
Park-and-Ride	2	4	2	3	4
Fare Collection	3	2	3	1	5
Cost Accounting	3	2	3	1	5
Flexible Paratransit	4	3	3	3	5
Coordinate Paratransit	2	2	3	3	5
Carpooling	2	2	2	2	2
Vanpooling	1	2	2	2	3
On-street Parking	2	1	3	2	5
Regulate Parking Supply	2	1	3	2	5
Regulate Parking Pricing	2	2	4	2	5
Preferred Spaces	3	2	3	1	4
Bikeways	3	3	2	3	5
Malls	4	4	2	3	5
Staggered Work Hours	3	1	2	2	4
Flexible Work Hours	3	1	2	2	5
Restrict Auto Access	2	4	3	4	4
Exclude Auto Access	4	4	3	4	5
Area Pricing (licenses)	3	3	3	3	4
Area Pricing (surcharge)	3	2	3	2	5
Auto-free Zones	4	4	3	5	4
Restrict Trucks	3	1	5	1	5
Signal Timing	2	2	2	1	3
Synchronize Signals	1	3	2	3	2
Computerize Signals	1	5	1	5	1
Bus Preemption	3	4	2	4	5
Channelization	3	2	2	1	3
Turn Lanes	2	3	2	1	3
One-way Streets	3	4	2	4	2
Reversible Lanes	1	4	2	4	2
Metered Access	2	3	2	4	2
Bypass Lanes	3	4	3	3	5
HOV Lanes	4	5	2	4	4
Freeway Ramps	3	4	2	4	5

*Rating: where "1" is the most desirable and "5" is the least desirable

Source: Office of the Governor, State of Florida, Transportation Energy Efficiency Manual. 1981

Figure 25

TEEM

RELATIVE RANKING OF ADVANCED STATE-OF-THE-ART MEASURES

File Number	Specific Measure Description	Relative Ranking
A.3.b.	Vanpooling	
A.3.a.	Carpooling	
B.1.b.	Synchronize/progress signal timing	**FIRST**
B.1.a.	Adjust signal timing	**PRIORITY**
B.2.b.	Separate turn lanes	
B.3.b.	Reversible lanes	
B.3.c.	Metered freeway access	
B.1.c.	Computerize signal control	
B.2.a.	Channelization	
A.7.a.	Staggered work hours	**SECOND**
A.1.b.	Park-and-Ride service	**PRIORITY**
B.3.a.	One-way streets/street pairs	
A.4.a.	Eliminate/restrict on-street parking	
A.4.b.	Regulate number/supply/location of parking spaces	
A.4.d.	Preferred spaces	
A.8.a.	Restrict/divert auto access	
A.7.b.	Flexible work hours	
A.8.c.	Area pricing (licenses)	
A.2.b.	Coordinate paratransit services	
A.4.c.	Regulate price of parking spaces	
A.1.c.	Simplified fare collection	
A.1.d.	Cost accounting	
A.8.d.	Area pricing (parking surcharge)	**THIRD**
A.1.a.	Express bus service (coord. with local service)	**PRIORITY**
A.5.a.	Bikeways	
B.1.d.	Bus preemption of selected signals	
B.4.c.	Exclusive freeway access ramps	
B.4.b.	High occupancy vehicle (HOV) lanes	
B.4.a.	Exclusive lanes to bypass congested points	
A.8.f.	Restrict truck deliveries	
A.6.a.	Malls	
A.8.e.	Auto-free zones	
A.2.a.	Flexible paratransit services	
A.8.b.	Exclude auto access	

Source: Office of the Governor, State of Florida, Transportation Energy Efficiency Manual. 1981

Figure 26

TEEM

INTERRELATIONSHIPS OF CATEGORIES OF MEASURES

CATEGORY	TRANSIT	PARATRANSIT	RIDESHARING	PARKING MGT.	BICYCLES	PEDESTRIANS	PEAK HOUR TRAV.	CONGEST. REDUC.	LAND USE PLAN.	TRAFFIC SIGNAL	INTERSECTION	VEHICULAR FLOW	PREFER. TREAT.	LIGHTING
TRANSIT		3	3	1	2	1	1	3	3	3	1	3	1	2
PARATRANSIT			3	2	2	2	1	3	2	2	2	2	1	2
RIDESHARING				1	2	2	3	3	2	2	2	2	1	2
PARKING MGT.					3	1	1	3	2	2	2	3	1	2
BICYCLES						3	2	1	1	3	3	3	2	2
PEDESTRIANS							2	1	1	3	3	2	2	2
PEAK HOUR TRAV.								2	2	2	2	2	3	2
CONGEST. REDUC.									3	2	2	3	2	2
LAND USE PLAN.										2	2	2	2	2
TRAFFIC SIGNAL											3	3	2	2
INTERSECTION												3	3	2
VEHICULAR FLOW													1	2
PREFER. TREAT.														2
LIGHTING														

LEGEND

1 = Complementary (Each measure expands the other's energy conservation potential.)

2 = Independent (Neither measure has a direct impact on the other's energy conservation potential.)

3 = Interdependent (Each measure must be designed with the other in mind to maintain and/or expand their combined energy conservation potential.)

Source: Office of the Governor, State of Florida, Transportation Energy Efficiency Manual. 1981

In general, TEEM uses as its results a basic formula based on energy use differentials: (See Appendix B)

$ES = E_0 - E1$

where
ES = energy saved
E_0 = energy consumed before the measure is implemented
E_1 = energy consumed after the measure is implemented

Each of the state-of-the-art techniques is then discussed individually, with an assessment formula provided as well as references to other sources where more information may be found.

TEEM is just beginning to be used in Florida. A number of demonstration efforts designed to utilize and "test" the methodologies are being initiated, dealing with a comprehensive TSM program of parking, ridesharing and traffic signalization projects in Orlando and the installation of a new signal system in Tallahasee. A demonstration was scheduled to be conducted in Jacksonville on a TSM program regarding the river crossings, but that program has run into difficulties and has not begun. TEEM now is being revised to include more methodologies and more examples of projects done in Florida.

There are a number of other aspects to TEEM program which are just beginning. One is the use of the interest in TEEM to assist in the development of an overall area transportation energy conservation plan, similar to those described in Section 7.a. Another effort being initiated is the provision of similar methodologies to calculate and forecast energy consumption of the overall street networks and long range network alternatives.

Another state within this study that has provided technical information to its MPOs regarding energy impact methodologies is Pennsylvania, through a relatively new program called the Energy Conservation Reduction and Safety Program, commonly called ECONS. This program is part of an overall effort by Pennsylvania to reprogram activities regarding transportation improvements away from new facilities and towards improvements to existing facilities. In 1977, the Commonwealth of Pennsylvania suspended its Capital Improvement Programs for transportation projects, indicating that under normal circumstances new roadway facilities or extensive capacity additions would no longer be funded.

The ECONS program is one of the alternative programs that has been instituted since that time. Under ECONS, the Commonwealth will reserve an amount of funds taken from various Federal-Aid categories to be used for projects with demonstrated beneficial impacts on energy consumption, highway congestion and highway safety. The prioritization of these projects will be

based on the results of a standardized impact methodology and the project' s benefits/cost ratio, also to be determined through a predetermined formula.

The Commonwealth has developed two analytical approaches that are to be utilized by MPOs in determining project impacts and the relative benefits of the projects. Type I analysis is a quick response method of analyzing corridors which have obvious, low cost energy efficient solutions to the congestion problem. These methodologies consist of manual calculations based on changes in travel speeds and VMT. Type II analyses require a more detailed analytical procedure because the project's potential benefits are not easily determined. Type II analyses require the use of the TRANSYT 7F modelling program, to be run through the Pennsylvania Department of Transportation computer facilities.

The Pennsylvania DOT has indicated to each MPO the data requirements of each of the two types of project analyses (Figure 27), as well as typical fuel consumption factors. It then provided the methodology for Type I projects which similar to Florida, determined the energy impacts as the difference between the overall fuel consumption (based on speed and VMT) before and after the project's implementation. A sample analysis provided by the Pennsylvania DOT to the MPOs is included in Appendix B.

In the Lehigh Valley area, this methodology was utilized to analyze the impacts of eliminating a number of 4-way stop signs. The analysis resulted in a benefit/cost ratio of approximately 6:1.

The Commonwealth has recently begun to provide assistance to MPOs in developing assessment programs utilizing the TRANSYT 7F model in more complicated and detailed projects.

One other State-initiated activity regarding energy conservation was found among the study area states. The Arizona Department of Transportation has developed the Arizona Transportation Energy Study. This effort consisted of four reports describing various aspects of transportation energy usage in Arizona, and was intended to serve as a resource guide to localities in developing energy conservation programs.

The first report, "Usage Patterns", presented data regarding energy use characteristics in Arizona. The second report, "Directions", acted as an issues paper discussing the State's dependence on fossil fuels and potential courses of action which could be taken to deal with shortages and to lessen its dependence. It identified five areas of energy conservation actions: Federal petroleum reserve policies, fuel distribution restrictions, parking management/carpooling, and optmization of facility utilization.

Figure 27

ECONS

ARTERIAL OPTIMIZATION
DATA REQUIREMENTS

Category	Type of Data	Corridor Selection	Type I Analysis		Type II Analysis
	Item Description	Categorize	Prioritize	Max Band	TRANSYT
Network Data	Intersection Geometry	X			X
	Link Distances		X	X	X
	Lana Widths				X
	Existing R.O.W.	X			X
	Turn Restrictions				X
	Parking Restrictions				X
	Bus Routes				X
	Mid Block Vol. Sources				X
Vehicle Volumes and Flow Parameters	ADT	X	X	X	X
	24 HR ATR Counts		X	X	X
	Turning Movement Counts	X			X
	Link to Link Movements				X
	Hourly Fluctuations	X	X	X	X
	Classification Counts		X		X
	Lane Usage				X
	Saturation Flows			X	X
	Start-up Lost Times				X
	Green Extension Times				X
	Link Free Speeds				X
	Bus Dwell Times				X
	Queua Clearance Times			X	
	Right Turn on Red Vols.				X
System Performance Data	Speed and Delay Study	X	X	X	X
	Field Delay Studies				X
	% Stopping Studies				X
	Platoon Dispersions				X
	Flow Characteristics	X	X		X
Traffic Signal Equipment and Operation	Number of Signals	X	X	X	X
	Signal Spacing	X	X	X	X
	Interconnection Exis. Operational?	X	X	X	X
	Equipment Condition	X	X	X	X
	Equipment Flexibility	X	X	X	X
	Maintenance Evaluation	X	X	X	X
	Existing Timing				X
	Existing Cycle Lengths				X
	Minimum Greens			X	X
	Pedestrian Interference				X
	Allow. Cycle Length Range			X	X
	Average Green Times - Actuated				X
	Allow. Left Turn Sequence			X	
	Existing Phase Sequence				X

Source: Commonwealth of Pennsylvania

The report then listed long-term conservation programs which could alleviate energy use in the State:

1) increase vehicle load factors;
2) improve vehicle technology;
3) encourage modal shifts;
4) increase travel costs;
5) reduce gasoline supply;
6) improve traffic movement;
7) minimize impact of construction of new facilities;
8) support transportation planning;
9) other measures (e.g. future speed limit reductions, variable work hours).

The third report, "Emergency and Long-Term Conservation", discussed in detail some of the implications of the strategies discussed in the Directions report, and the fourth report, "Energy Use Management Plan", investigates the energy use management process and describes the steps necessary to establish an effective energy use management system.

The Energy Study provides an overview to Arizona's metropolitan areas of the type of things it should be considering related to energy conservation. No methodologies are suggested for analyzing potential projects, but the Tucson area, for example, has been analyzing in more depth a number of the TSM type of measures that were suggested, most notably parking management, carpooling and optimization of facility utilization.

FINDINGS AND CONCLUSIONS

A. Factors of Influence

The preceding sections were designed to illustrate the various manners in which a "representative" sample of mid-sized MPOs have incorporated, are attempting to incorporate, or have yet to incorporated energy conservation into their ongoing transportation planning process. The selection and analysis of these nine areas was undertaken in order to do two things: 1) to determine if there are some general trends common to MPOs as a group within a similar size range, compared and contrasted with larger or smaller sized MPOs; and 2) to determine what particular differences and similarities there may be in characteristics of MPOs within the size grouping, in order to gauge the effect of these characteristics on each area's energy conservation related activities.

A number of factors originally thought to be potentially significant determinants of energy related activities turned out to be relatively unimportant. Among these factors were the composition of the MPO Policy Board, the agency within which the MPO staff was located, and a number of absolute demographic and travel characteristics: total population, DVMT, the number of central cities, etc. It appears that rate of growth of these factors plays a much more important role in determining appropriate MPO work activities and the importance of issues such as energy conservation. Those areas where population, employment, DVMT, etc. were rising rapidly, for example, tended to be similar in their work and outlook regarding energy than did those areas which were particularly similar in total population and DVMT.

Areas towards either end of the study's population parameters (200,000 to 750,000), clearly were different in their characteristics and transportation issues, and it could be argued that they more closely resemble urbanized areas outside of these artificial boundaries; the decision as to the parameters was somewhat arbitrary. On the other hand, all of the areas were quite similar regarding certain transportation issues, travel behavior and public perceptions, particularly as these relate to energy considerations, and therefore it is believed that these nine areas provide a representative "cross-section" of mid-sized areas from which to generalize and contrast with other sized MPOs.

The overriding factor which appears to affect MPO related energy conservation efforts is the level of traffic congestion

experienced throughout the urbanized area. These mid-sized areas were very similar in this regard; generally, the overall level of traffic congestion experienced was fairly low, certainly of a magnitude much lower than large metropolitan areas. Where congestion problems do exist, they tend to be localized, last a relatively short period of time, and center around traffic operational problems rather than capacity problems. This was true in almost all of the areas under study.

One reason for these characteristics is the spatial patterns which dominate mid-sized areas. The metropolitan areas were most often characterized by a low density, sprawl pattern of development. With one exception, the central city CBD has been losing its degree of traffic attraction, and business and commercial areas of employment were scattering along the area's highways and arterial corridors. The highway network throughout the area is relatively convenient. This results in a dispersed pattern of trip making, a lack of areas of concentrated trip generation and trip attraction, and thus relatively free flow travel conditions. This is borne out by the estimates of average trip distances and travel times.

This prototypical development pattern was found in almost all of the mid-sized MPOs, suggesting that the metropolitan areas of these sizes tend not to experience severe enough traffic congestion to cause changes in personal travel behavior (this is not to say conditions are not expected to worsen; only that this is a factor of rate of growth and the ability of the transportation infrastructure to support such a growth rate, rather than absolute size itself).

It is this last point that is significant in discussing energy considerations in these areas. Experience has shown that measures designed to reduce energy usage are not likely to be accepted by either local officials or the public at large in areas where traffic congestion is not a significant problem, unless travel disincentives are put into effect. These disincentives were not found to be in place in these mid-sized areas, and thus energy conservation is not a major concern.

This fact is, by and large, a surprise to transportation planners, economists and social scientists. Many of these "experts" believed that the price of fuel would become the major determinant of travel behavior by the late seventies or early eighties. Many people concluded that once gasoline fuels reached $1.00/gallon, for example, measures which reduced VMT would be embraced wholeheartedly. Indications of such behavior in many areas during the 1973 and 1979 fuel crisis supported this belief. However, experience has shown that it was concern about the availability of gasoline during the crisis, and not the cost,

that generated interest in alternative modes of travel. Once supply shortages were alleviated, even though price remained high, travel behavior generally began to revert to pre-shortage trends.

The price of fuel was nevertheless an important factor for a number of people. However, rather than coping with vastly increased commuting costs by turning to transit use or ridesharing, a larger number of these cost conscious individuals dealt with this problem by purchasing newer, more fuel efficient vehicles. This behavior has led to a situation where operational costs of vehicle usage has remained the same, or decreased, in spite of fuel cost increases, because of greater fuel efficiency (of course, a capital cost was involved, but this does not appear to be as significant as out-of-pocket costs). Those drivers most affected by fuel prices have thus made changes based on these prices, but done so in such a way as to enable them to maintain or increase their total mileage.

Discounting the cost of gasoline as a major disincentive to energy inefficient driving habits, there are two remaining potential disincentives. One is a significant increase in non-fuel related out-of-pocket costs, most commonly evidenced by new or increased tolls and high or increased parking fees. This is not evidenced in these mid-sized areas, as daily or monthly parking rates in downtown areas (where fees are highest), are extremely low. It was unusual in the areas under study to find daily parking rates of more than $2.00, and in most cases it was lower. Nor was the availability of parking a particular problem in most of the areas.

With out-of-pocket costs generally considered insignificant in these areas, the only remaining disincentive to drive (and drive alone) is traffic congestion. While this is more of a psychological than an economic disincentive, it appears to be important. If severe traffic congestion is experienced on a daily basis, people are willing to consider changes to the system: supporting traffic improvements to alleviate the congestion, participating in a system where one would experience the congestion fewer times per week, or not personally experiencing it at all. If congestion exists, therefore, energy conservation strategies such as carpooling, transit use, HOV lanes, etc. can become viable alternatives. In areas with little congestion, short travel times and distances, inexpensive and convenient CBD parking, it is unlikely that these same strategies would be well utilized. Conservation policies which appealed to reducing congestion were successful. In other words, congestion reduction was more popular than conservation for its own sake.

B. Energy Conservation Priorities

It is therefore not surprising that the public's "energy consciousness" regarding transportation is low in these mid-sized areas, given the prevalent development and travel patterns. The MPOs in these areas, therefore, face a difficult task in any attempt to pursue more efficiency in the transportation network for the purpose of conserving energy. Nevertheless, the MPO staffs in these areas have demonstrated a willingness to develop some type of program which includes energy conservation as one of its goals.

This willingness is based on a number of factors. A common belief among transportation planners is that, in spite of the current oil glut, future energy emergencies are inevitable, and long-term continued dependence upon petroleum sources to the same degree that currently exists would have grave implications for the viability of the area's transportation and economic systems.

Given this foreboding scenario, and existing travel behavior trends, MPO planners in the study areas were fairly realistic about the type of things that need to be done in order to reduce current levels of dependency. Given the continued ease of automobile usage in these areas, energy conservation strategies tended to be prioritized in the following order:

Strategy	Priority
Increase vehicle fuel efficiency	1
Alter existing land use patterns	2
Increase the fuel efficiency of individual trips	3
Reduce total number of trips	4

Increasing the fuel efficiency of vehicles is considered the most effective strategy, particularly in rapidly growing areas where a large number of additional vehicles are anticipated. However, this is a national policy decision and unlikely to be influenced by local agencies.

Several MPOs indicated that an alteration of land use patterns away from presently experienced low density, dispersed sprawl towards more efficient, higher density, clustered activity center patterns would do more for energy conservation than any local transportation measure. While land use policy is an activity that many MPO staffs also develop as part of their other COG or RPA related activities, all believed that the chance of affecting serious changes in existing patterns and policies would be unlikely, particularly if such effects were initiated as part of a tranportation strategy. These land use changes rely to a large degree on higher densities, which make transit service more

viable, because of increased ridership potential and more efficient operating costs. However, the prospect of reduced Federal operating subsidies make the large scale service expansions necessary to support increased ridership financially questionable unless they are supported totally by local sources, an unlikely possibility.

Nevertheless, the general feeling is that in these dispersed mid-sized areas, land use changes hold significant energy conservation potential. This theory has also been advanced in large metropolitan areas. For example, the Washington COG has estimated that an alternative land-use pattern in that area could be as much as 31% more efficient than the most consumptive sprawl alternative*, although some experts claim that the benefits of such changes are highly over-estimated.**

The third priority is generally focused on improving the existing efficiency of the trips that are made through traffic flow improvements. Two basic reasons are advanced for prioritizing this group of strategies. The most obvious is that they require no changes in personal travel behavior; but the fuel efficiency of this behavior would become greater. Secondly, the benefits of such improvements are immediate, both in terms of energy conservation and other benefits. Once an improvement is implemented, all of the benefits accrue as soon as the system is operational; there is no need to "wait" for travel trends to change or for people to decide to take advantage of the strategy. Traffic flow improvements found to be most beneficial are signal synchronization projects, intersection improvements, arterial improvements, one-way pairs, and reversible lanes.

The fourth priority, strategies that reduce trip-making, is problematic because it relies on personal behavior changes and is not necessarily permanent, as indicated by the interest in ridesharing and transit in 1979, but the drop-off in interest after the "crisis" had passed. These strategies are generally believed to have less overall potential in these mid-sized areas with some exceptions. Employer-based ridesharing, for example, is seen as a program with a high benefit/cost ratio, much higher than area-wide programs. In addition, if a program is strongly supported, and can be shown to be an alternative to much more expensive additional roadway capacity, it has more of a chance to be successful.

---

* Metropolitan Washington Council of Governments. Energy, Land Use - Growth Policy for Metropolitan Washington, August, 1975.

** Altshuler, Alan. The Urban Transportation System, MIT Press, 1979.

Most of the MPOs support reduced VMT strategies within their work programs, and in some cases believe that impacts can be almost as beneficial as traffic flow improvements. They can also be most easily shown to save energy. Each carpool, for example, can show the total number of gallons of gasoline saved; the savings are clear and easily understood.

C. Role of Energy Conservation

All of the MPOs believed that energy conservation was an important factor to consider in both short and long range transportation planning, some even suggesting that it was the most important factor. There was also agreement that the only way that energy conservation will be prioritized as a major concern with both public officials and local residents is to have another serious energy shortage or interruption take place.

Short of this possibility, the most agreed upon "role" of energy conservation in the transportation planning process in mid-sized areas is to use energy as one of a number of assessment and impact criteria. In certain instances, given a particular set of circumstances, it might be given more weight by decision-makers than other criteria, but generally the energy impacts of a project should be evaluated "pro forma" just as its travel impacts, economic impacts, environmental impacts, and air quality impacts are evaluated. Energy usage by itself is not a "strong" enough variable to promote a project by itself; it is more likely to act as a supportive, secondary benefit.

Fortunately, many of the transportation strategies now analyzed and prioritized by MPOs in the transportation planning process are TSM-type of measures which generally have beneficial air quality and energy consumption impacts, in addition to the primary traffic benefit. A community can synchronize its traffic signals downtown or along an arterial and people will support this expense because it will enable them to get to their destination faster. The fact that they will be saving energy and improving air quality is also nice, if pointed out to them, but the most important fact is still that they are getting to work faster. An equivalent amount of gasoline might be saved if a number of these people rideshare (more money would be saved as well), but such programs are unlikely to be as well received, because energy conservation becomes a primary rather than a secondary benefit.

Transportation improvements designed primarily to save energy will not be perceived as important unless there is an immediate energy problem or unless a more "reasonable" alternative within traditional transportation problem solving cannot be found. An example of this was found in one area where efforts to encourage the county to implement a ridesharing program was not met with any enthusiasm. In a seemingly unrelated problem that later arose, it became clear that additional parking spaces to serve a public building would have to be constructed. Money for such construction was not available. At this point, however, interest in the ridesharing program was expressed, as an alternative to "the traditional" solution, which in this case was an infeasible option.

In addition, even if an attempt could be made to pursue projects due to their energy impacts, at what point is a benefit significant? For example, the Colorado Springs "activity center" long-range transportation network alternative indicated a 10% overall reduction in energy consumption, yet the planners were disappointed that the results were not more dramatic. It was felt that these impacts (along with similar transit use impacts) were not significant enough to expect policy makers to support what would be perceived as radical alterations in the existing system. Without standards or particular goals to be reached, these impacts will be difficult to assess, particularly when viewed in light of the costs of implementation. Overall cost benefit analyses may be difficult to structure as well because of the particular distribution of these costs. For example, a project may be particularly expensive, but one result is that money now flowing out of the country for imported oil may still be spent, but now will be spent within the country on labor, parts, etc. These are fairly sensitive policy judgements that are difficult to assess objectively.

D. MPO Roles Regarding Energy Conservation

The information developed during the course of this study has indicated quite clearly that "mid-sized" areas exhibit considerably different characteristics regarding transportation-related energy usage than do large metropolitan areas, and therefore the activities that MPOs can and should undertake regarding energy conservation differ as well. One of the attractive features of the "lifestyle" of many of these areas, particulary to new residents, is the ability to get in your car and travel to most places within the metropolitan area in a very short time. These people are not likely to be particularly concerned about transportation related energy usage or costs. Since congestion and traffic are also not a particular concern, it is difficult to expect programs designed to reduce energy consumption through alternative modes to be well received. Potential strategies such as HOV lanes are not generally viable options, and are unlikely to be well supported. Things such as park and ride lots may be acceptable because of their minor negative impacts, but are not likely to be utilized to any significant extent.

It thus appears that special comprehensive energy conservation programs designed to emphasize and prioritize energy conservation strategies may not be a particularly appropriate expenditure of transportation planning funds, as they exist at the present time. A number of the areas studied have experimented with this type of effort, and the results have not been particularly promising. Often there is a negative reaction within the MPO policy body itself as to the propriety of such an effort, particularly when the analysis leads to recommendations outside the transportation field.

Given these areawide characteristics and the results of a number of individual efforts related to energy conservation, it appears that there are a number of roles that may suggest themselves for mid-sized area MPOs.

1. Institutionalization of Energy as an Analytical Criterion

The most common suggestion voiced regarding MPO roles was that concerned with the use of some form of energy consumption impact procedure as a part of the standard transportation planning analysis of plans, programs, and projects. This impact could be included as one of a number of impacts that are analyzed. Those areas with operational UTPS forcasting models are generally including an overall consumption impact in their long-range network alternatives; some energy impact analysis is being undertaken on TSM measures, usually those analyzed in the

air quality programs as potential TCMs with VMT reduction potential; little is being done on TIP projects at the present time, although some efforts in this regard are being considered.

The situation regarding energy is somewhat analogous to air quality planning prior to the Section 175 program. Before this time, air quality impacts were rarely analyzed and used as a criterion for project prioritization. A major "special" effort regarding air quality was set up, additional funding was provided, etc. The usefulness of this program and its overall results may still be subject to considerable debate, but one particular result is clear: air quality impact analysis has been "institutionalized" into the transportation planning process. Whenever a project or program is discussed now, its air quality impacts are included as part of this analysis. There is still particular emphasis on air quality due to the SIP submittals and ability to meet 1987 standards, but it is likely that once these are resolved, air quality will then become a standard analytical impact, and used as part of the overall decision-making.

Energy consumption impacts have not yet been similarly institutionalized. Whether a "special" program analogous to the air quality program is necessary in order to do so is not necessarily a relevant question. This is because energy supplies are now considered to be plentiful thus there would likely be support for such a program.

2. Public Information and Education

One concern common to most of the MPO staffs related to the short-sightedness of most people regarding energy as a problematic issue. There is a general belief by planners that the current oil glut is at best temporary, and that shortages will appear again, or that prices will rise to a point (not as yet reached) that will make current travel behavior unaffordable to many people. Only time will tell if this belief will indeed be borne out. The interest shown on the public's part in energy conservation measures experienced in 1973 and 1979 has waned, and long term conservation strategies do not appear to generate any level of interest.

Given this situation, there is a perceived need for a continuous public education program to be set up which will keep the need for energy conservation in the public's attention. This will help to alleviate the "crisis" situation that arose in the previous shortages. If future shortages do not occur, there is a risk that the public will resent public officials "forcing" unpopular travel alternatives into existence, yet energy efficiency has been generally accepted as a public policy.

3. <u>Continue to Encourage Alternative Modes</u>

The MPO transportation planning process is by definition multi-modal, and efforts to encourage use of alternative modes is believed to be an important MPO activity that needs to be continued, even in the face of foreboding trends. Ridesharing efforts in these size areas do not have extremely high potential, and the uncertainty of future transit system financing makes expansion plans difficult to promote. Nevertheless, any program which reduces VMT via alternative modes does save a measurable amount of energy, and there was general agreement that it is important to continue to encourage these modes. This need not be just an MPO activity, and in fact needs strong public support from local officials as an indication of its importance. It is in these types of efforts where visibility and support is as important as the quality of the program itself.

4. <u>Interrelationship Of Transportation Energy and Land Use</u>

In most of the areas studied, it was believed that none of the specific transportation programs designed to reduce vehicle energy consumption, (and, in some cases, all of them put together), would be as effective as the institution of more energy-efficient land use patterns. These mid-sized areas generally have a dispersed, low-density development pattern that discourages or inhibits significant use of public transportation, ridesharing, bicycling, or pedestrian modes of travel. Although there is some controversy as to how much energy could be saved via land use changes, there is a belief in these sized areas that a cluster of activities into concentrated areas, higher density development along certain travel corridors, and zoning changes regarding parking could all contribute to the overall reduction of travel-related energy use.

As most of the MPOs are staffed primarily by the area's comprehensive planning agency, it is a natural function for the transportation plans to consider land use, and the comprehensive plans to consider energy use. While this is generally true in terms of policy plans, it is difficult to have these principles translated into actual practices. Communities are reluctant to alter existing development patterns, even where beneficial impacts can be shown. MPO policy bodies are often uncomfortable when transportation activities begin to "infringe" into other areas. This is particularly true among those agencies, such as State Highway Departments, whose activities traditionally have been traffic & roadway related.

The relationship between land use and transportation is likely to become more evident in light of increasing scarcity of funding. Localities, for example, are generally used to a situation where a congestion problem is most often remedied by the provision of additional capacity, such as new highways, bypasses, or roadway widenings. These projects have traditionally been financed primarily with Federal & State funds. With a reduction in funds from these sources (e.g. Pennsylvania dropping its roadway capital improvement program in 1977), it is now becoming more difficult to get these types of projects funded. Many localities still assume, however, that once a problem gets bad enough, capacity improvements will have to be undertaken. Once it becomes clear that local funding may be the only way to make this happen, then the interrelationship between land use patterns and the transportation system will begin to be more clearly seen. This is another example where the energy benefits would be secondary to the potential financial benefits of reducing the need for new transportation facilities.

Even though this is a difficult activity, it nevertheless appears to be necessary, and a natural function of the MPO's work program, particularly when carried out by a part of a comprehensive planning agency.

5. Energy Contingency Planning

The energy contingency planning activities mandated by Federal agencies in 1979 has also received somewhat mixed reviews from those paticipating. Many problems arose out of the difficulty in discussing contingency rather than conservation strategies. There is a feeling that a base of certain conservation measures is necessary in order to have contingency measures actually work in an emergency situation. Another feeling was that by limiting the effort solely to some future "emergency", it discounted the need for ongoing, long term changes in travel behavior that will lessen the dependence upon petroleum based fuel, and therefore lessen the possibility of the severity of future supply interruptions.

Nevertheless, most areas believed that energy contingency planning is a worthwile effort, and a particularly appropriate one for the MPO to undertake as the lead agency. One obvious reason for this belief was the aforementioned common perception that future shortages were likely. Secondly, the guidelines provides some specific "support" for getting more heavily involved with transportation related energy considerations in their ongoing planning process. Justification for assessing various conservation strategies, analyzed as part of the energy

contingency process, was readily available. There was little questioning of the propriety or the need to do so.

It was generally agreed that energy contingency activities continue, not in its initial format nor as a mandatory annual update of the Plan, but in periodic review of the mechanisms initially recommended, and through efforts to begin to implement some conservation strategies which would act as a basis for particular contingency emergency measures.

APPENDIX A

Tucson, Arizona

The Tucson-Pima County urbanized area is the second largest metropolitan area in Arizona, located in the southern portion of the State approximately 100 miles south of Phoenix. The area contains large acreage of publicly owned land and Indian reservations, and is a short distance from the U.S./Mexico border. The area has been characterized by extremely rapid growth in the past decades as indicated by the following population levels:

1960 - 265,000
1970 - 351,000
1980 - 551,000

Population forecasts indicate that this area will be the fastest growing urbanized area in the country in the 1980's and a doubling of the population to slightly over 1,000,000 people is predicted by the year 2000. The area in the past has been interested in slowing down its growth, but this attitude has fluctuated depending upon economic conditions. Given the present state of the economy in the area, it is actively seeking increased economic activity.

The growth recently experienced and that expected to continue in the future tends to be farily typical low density, sprawl type suburbanization. Commercial and industrial growth is occurring outside the central business district and therefore there is a considerable amount of cross-commuting rather than heavily oriented towards the downtown. Although Pima County covers 9,300 square miles, 94% of total population is expected to remain within a 300 square mile urbanized area surrounding Tucson in Eastern Pima County.

MPO Structure

The Pima Association of Governments (PAG) has been designated as the Metropolitan Planning Organization for the Tucson urban area. The PAG is composed of Pima County, the City of Tucson, the City of South Tucson, the Town of Oro Valley and the Town of Merana. The Transportation Planning Committee is the policy board for transportation matters, and it is composed of senior transportation and planning officials from the PAG member jurisdictions, as well as representatives from other agencies and institutions. The City of Tucson has 3 voting members, Pima County has 3 voting members, the 2 towns each have 1 voting member, the City of South Tucson has 1 voting member, the Airport Authority has one member, and the Arizona Department of Transportation has 2 members, for a total of 12 voting members.

Represented as ex-officio members are PAG staff, University of Arizona, Davis-Monthan AFB and the Federal Highway Administation.

The MPO staff in the area is unusually arranged. The Transportation Planning Division of the Pima Association of Governments is responsible for the MPO's work activities, but the Division is actually a segment of the Arizona Department of Transportation. The Director of the Transportation Planning Division and its 10 member staff of planners and engineers are employees of ADOT who also report to PAG and its Transportation Planning Committee. Other transportation related activities such as the air quality program and the ridesharing program are operated out of another section of PAG, not the Transportation Planning Division. The City of Tucson has a traffic division but no MPO funds are passed on to the city.

Transportation Network Characteristics

The Tucson area's transportation network accommodates fairly dispersed travel patterns. While the CBD remains a major activity center, it is relatively small given the population of the area, with only about 10-12,000 employees. The suburban areas are growing much more rapidly, and there is no strong retail presence in the CBD. Major employers such as IBM and Hughes Aircraft have been locating their new facilities on the outskirts of the area, but there has been no concentration of employment centers. The Air Force Base to the southeast is a major traffic generator as well.

The major arterials radiating from the CBD and into the suburban areas are characterized by commercial strip development and its associated traffic problems. The typical commuting trip averages approximately 17 minutes and covers a distance of 6.2 miles.

The Transportation Planning Division has identified a number of arterial corridors that are experiencing congestion problems, and two dozen problem intersections as well. In an area growing as rapidly as this one, additional roadway capacity needs of the future are likely to be substantial. New capacity projects have become controversial in the past and continue to be at present, particularly regarding neighborhood impacts. The area has rejected a new Interstate project and is developing an Interstate substitution program. There are a number of corridor projects and arterial improvements which are being developed in conjunction with neighborhood groups. A system of reversible lanes in peak hours in heavy volume corridors leading to the CBD is being implemented as an alternative to additional capacity. The area has relatively few miles of limited access highways, and most of the travel occurs on arterials. Average VMT is estimated

to be almost 8 million per day in 1982, with an estimate of 17.8 million by the year 2000, although this has been reduced to 15.8 million after adjusting for energy cost factors.

Transit

The City of Tucson has operated a municipally owned transit system, SUN TRAN, since 1969. The system has a fleet of 151 vehicles operating on 22 bus routes. SUN TRAN has a basic fare of 50¢, which was increased from 35¢ in 1980. Ridership had been rising moderately during the late 70's, but decreased after the 1980 fare increase and deficit related service cutbacks. FY'81 ridership was approximately 35,000 daily passengers and 8.7 million yearly passengers, which is approximately 2-2.5% of total trips. Estimates are that with major improvements to the system, it could have the capacity to accommodate 6% of total travel by the year 2000.

The city does most of the transit planning in the area with the PAG including transit in its long range programs. Approximately 1/3 of daily weekday ridership is composed of reduced fare school trips, either public schools or University students.

Surveillance

The Transportation Planning Division, in conjunction with the Arizona Department of Transportation, conducts a fairly extensive surveillance and monitoring program. Data is collected on VMT growth, vehicle occupancy, travel time and delay, intersection capacity, transit information and accident statistics. It is also in the initial phases of a number of monitoring programs to determine the effectiveness of transit service changes and the ridesharing program. The computer assisted signal system operated by the city is able to monitor traffic flows, travel delay and intersection congestion. Vehicle occupancy varies between 1.15 and 1.48 depending upon time of day and location. Work trip vehicle occupancy is estimated to be 1.18.

As part of its contingency program, the staff did utilize State records to obtain the fuel consumed in Pima County on a yearly basis from 1970 to 1980. The staff had anticipated developing a more extensive monitoring program of fuel consumption trends, but the Policy Committee felt it to be too expensive an activity that was not justifiable given other priorities and funding limitations.

Traffic Modelling and Forecasting

The Transportation Planning Division maintains a fully developed and operational UTPS network, using the basic ADOT computer mainframe facilities. The staff maintains one full-time computer programmer to keep the network and its data files updated. The air quality program, conducted by another section of the PAG staff, utilizes Mobile I on computer facilities at the University of Arizona's Tucson campus.

The UTPS network has been adjusted to account for likely energy cost scenarios. The TPD developed a most probable transportation energy scenario for the Tucson region, determined the impacts of this scenario on transportation costs, and then developed adjustment factors for the future travel demand forecasts to reflect the higher costs of travel. Since the basic model correlates per capita vehicle trips with family income, it was assumed that higher costs of energy would be incorporated into the model by reducing the increase in family income, to reflect the amount of the increase that will go directly into energy purchases and maintenance costs. This assumption was that by the year 2000, the cost per gallon of fuel, in terms of 1979 dollars, would be $4.42. This was computed to be similar to a 10% decrease in real household income, so the income factor of the forecasting model was thus reduced by 10%. The result was a 10.2 reduction in projected internal vehicle miles travelled in the year 2000.

Energy Related Activities

Reduction in energy consumption does not appear to be a high priority concern in the Tucson area. As in other fast growing areas, automobile ownership per capita is increasing as is total VMT, so that roadway capacity and flow become the overriding concerns. The most significnt strategy to reduce consumption given these much higher VMT totals is a further increase in the fuel efficiency of individual automobiles. While some of this can be done through traffic operations improvements, development of more fuel efficient vehicles is the most important factor, and one that cannot be controlled at the local level.

The gasoline crisis in 1979 did not have a particularly serious impact on the Tucson area. There was some short waits at stations and some station closings, but no real gas lines or panic buying. A slight increase in transit ridership and ridesharing formation was seen, but not at significant levels.

There has been some official city interest in energy conservation. The mayor set up a Metropolitan Energy Committee,

a blue ribbon panel to provide public education regarding energy usage, and the city has an Energy Coordinator. The Committee worked with the PAG to develop the Energy Contingency Plan. The City has a number of adopted policies in its Comprehensive Plan regarding the need to reduce sprawl by increasing densities, but these general policies have not been followed in individual growth and development decisions.

The MPO Policy Board has generally supported activities and programs which will result in energy conservation, but not as a prime motivating factor. A program of energy related surveillance activities proposed to the Board by the staff was rejected as being too costly, given its perceived need. An element in the United Work Program to analyze energy conservation measures and their costs and benefits in the Tucson area was eliminated due to staffing problems and the fact that it was not an immediate need or high priority item.

In spite of the difficulty in developing specific energy activities, the MPO appears to be committed to an ambitious TSM program of improved traffic flows and encouragement of ridesharing activities as a method of reducing the amount of new roadway facilities that will be necessitated by the area's continued growth and development. The long range plan discusses a number of TSM measures as to their potential savings in lane-miles of new roadway improvements. The amount of funds allocated to these TSM measures might have been difficult to get approved if their main benefit was air quality or energy conservation. However, seen in the light of the growth needs, these become "other, secondary" benefits to new construction reductions.

The area's overall short range TSM plan suggests that there are fifteen performance criteria that should be used to assess any particular project, and energy consumption is one of these fifteen. The TPD has not, as yet, developed methodologies to perform energy assessments on their TSM projects.

The TPD believes the most useful project to reduce energy consumption is traffic operation improvements. These, however, are being advanced for other reasons, primarily reversible lanes and signal sychronization. The ridesharing program has been a fairly effective program and goals have been set to double the commuters who participate in ridesharing activities. There are TSM goals to expand the number of park and ride lots and express bus service, which are now operating at minimal levels. Activities designed to reduce peak hour congestion, such as staggered work hours, and promotion of trip making in off-peak hours, are low cost, public education programs that are likely activities of the MPO.

Colorado Springs, Colorado

The Colorado Springs urbanized area is Colorado's second major metropolitan area, located some 70 miles south of the largest, the Denver metropolitan area. The area is located at the base of Pikes Peak and the Front Range of the Rocky Mountains. This limits the area's development to the west, but growth in other directions has been rapidly occurring. This rapid growth, both population and employment, is the most significant characteristic of the Colorado Springs area which affects its transportation planning related activities. The area grew in population from 143,000 in 1960 to 235,000 in 1970 (a 65% increase), to its 1980 level of 309,000 (a 31% increase). 90% of the total present population (277,000) is located within the 137 square mile urbanized area. At one time during the late sixties and early seventies, the area was growing at an annual rate of 6-7%. Even though recent growth has slowed to 2-3% per year, it is still projected that the area will increase in population by 80% in the next two decades, and reach a year 2000 population of over 550,000. The lowered growth rate in recent years, resulting primarily from the national recession and corresponding declines in the local economy, has tempered earlier concerns about the quality of life resulting from such rapid growth.

Employment opportunities in the area have grown rapidly as well, with a 1982 civilian employment total of 131,000, compared to just 82,000 in 1974. In addition, the military influence of the area is very high with four major military bases as well as the Air Force Academy, adding a military labor force of another 30,000. A new military space center projected to open in 1986 represents another significant generation of both population and employment.

MPO Structure

The Pikes Peak Area Council of Governments is a voluntary association of elected officials from the general purpose local governments in El Paso, Park and Teller Counties. It has been designated as the Metropolitan Planning Organization for the region. The Urban Area Policy Committee is responsible for the formulation of policies, plans and programs necessary to the transportation planning process in the urban area. Voting membership on the Urban Area Policy Committee includes one representative from each of the general purpose local governments within the urban area (Colorado Springs, Monitou Springs, Fountain and El Paso County). The Colorado Department of Highways and the Colorado Air Quality Control Commission each have one ex-officio, non-voting representative on the Committee. The MPO also has a Transportation Advisory Committee, composed of

representatives of transportation agencies, which acts as a technical committee; and a Community Advisory Committee.

The transportation staff of the Council of Governments consists of (at the present time) one full-time transportation coordinator and one part-time transportation planner, although the department is currently understaffed. The COG conducts most of the long range roadway and transit planning analyses. The City of Colorado Springs operates the transit system and conducts short range transit and roadway planning functions; funds are passed through the COG to the City for these activities. A fairly successful ridesharing program is also operated in Colorado Springs.

Transportation Network

The major transportation issues in the region, particularly given its high growth rate, deal with traffic movement and congestion. The need for improved signalization along the area's major corridors, additional downtown parking and additional physical capacity of many of the area's roadways are seen as critical transportation needs. The city is a heavily pro-growth area, and new or expanded economic development, particularly light industry and "high tech" firms is being pursued. The predominant land use pattern is low density single family homes, over a widening area. The area is constrained by the Rocky Mountains on its western border, but has substantial areas available for development to the north and east. Future growth, though slowing somewhat, is expected to continue to follow this trend.

The Regional Transportation Plan recently finalized has estimated that roadway and transit system capital improvements necessary to adequately move anticipated travel demand by the year 2000 will cost over $250,000,000 in 1980 dollars, with an additional $100,000,000 in private sector financing for arterial roadway system improvements in newly developing areas. Analysis of population characteristics indicate that VMT growth is highly correlated with family income, and the income levels of new growth in the area is rising sharply. Future DVMT growth is expected to outstrip population growth. 1980 DVMT are 4,200,000 daily miles of travel; year 2000 estimates show a 170% increase to 11,570,000 vehicle miles per day. A slow growth scenario developed as part of the Transportation Plan indicated a 2000 figure of only 6,000,000 DVMT, but all concerned believed that to be unrealistically low.

While the outlook for the future of the roadway system appears bleak unless new roadway improvements are made, the existing system is not as yet functioning at an advanced state of congestion. Major areas of congestion tend to be centered around the industrial and office park areas outside of the CBD; the Interstate interchanges and the arterials leading to these areas, particularly the Garden of the Gods Industrial Area, experience peak hour congestion. Problems also arise with signalization on major arterials impeding traffic flows. Downtown congestion is not a serious problem, although parking shortages are perceived, primarily due to a city policy not to require new parking facilities with new developments. The CBD in Colorado Springs is generally characterized by financial, banking and insurance related offices, with the new high tech employment locating in park areas outside of the CBD, although most of this is still within the Colorado Springs city limits due to an aggressive annexation policy. The result is that the City of Colorado Spings contains 214,000 of the 279,000 people within the urban area boundaries. There is generally a very low vehicle occupancy rate for the work trip (1.15) and the work trip length averages between 6 and 7 miles. There is some commuting to the Denver Metropolitan area 70 miles to the north, as that area is continually growing southward, with the introduction of Tech Center and the conversion of large ranch acreage into development areas.

Transit

The transit system (Springs Transit) is operated by the City of Colorado Springs. It maintains a fleet of 38 vehicles in service on a daily basis, and currently serves approximately 10,000 riders per day (0.6% of total trips) with 1,500 utilizing transit service for their commute to work (1.4% of work trips). The basic fare is 50¢. There is interest in the city in expanding the system to serve more of the rapidly developing urban area. During the next four years, 25 new buses are anticipated to be added to its fleet, increasing its capacity by over 50%. The problem now is that existing service only covers approximately 10% of the area where most work trips are made. There is no express service, partially due to the fact that work trips are too short and congestion not heavy enough to expect people to switch to public transportation. Although ridership is not very high, the City has expressed a desire to continue to support the system.

Transportation Modelling and Forecasting

The COG staff at the present time has somewhat limited capabilities regarding traffic forecasting and computer assisted modelling techniques. The Comprehensive Plan recently completed was based on UTPS, whose modelling was developed primarily by the Colorado Division of Highways. The modelling applications for the area was difficult to calibrate due to the rather large percentage of trucks and recreational vehicles and the high degree of recreational trip making. The air quality analysis was conducted for the COG staff by an outside consultant.

The COG has recently purchased a microcomputer, and is currently investigating its potential use as a tool for sketch planning techniques, particularly now that the input for the UTPS model has been collected and will be maintained.

Surveillance

The COG relies to a large extent on the State Division of Highways to conduct much of the surveillance activities in the area, although the COG does develop the program regarding the necessary data to collect. The Division is responsible for VMT data and accident data; information is also kept current regarding transit ridership, auto occupancy and travel time, vehicle registrations, carpooling use, and levels of service. Estimates of fuel consumption are made by the State on a Statewide basis. Monitoring of fleet size or turnover of fleet has not been developed as an ongoing activity.

Energy Conservation Activities

The public perception of the need to conserve energy in the Colorado Springs area appears to be very low. It is a high growth area; the need to expand the roadway system to meet anticipated demand is very high. Many people have moved here from other areas where their daily commuting costs were much higher. There were no problems or inconveniences experienced by the 1979 energy crisis; in fact, gasoline prices remained much lower than those experienced in other areas of the country. MPO analysis of alternate facilities such as HOV lanes and high speed rail proved to have very low cost-effectiveness given personal driving habits and the dispersed development patterns which exist.

Improvements to the existing traffic network that improve traffic flow, and thus, improve air quality, and energy efficiency, are considered by the COG to be useful measures to pursue in the region. The City has a master signal

synchronization system, and is in the process of putting more and more of its signals on line.

The area is also promoting a ridesharing program, which has been successful to some extent despite dispersed travel patterns. It has been estimated that 17% of those commuting to work utilize some form of carpooling program. The program's computer based system is now expanding into large employers, schools, and the military bases where the impacts will be more greatly felt than individual matches.

Interestingly, although energy is not a major concern, air quality is perceived as important, as the residents are fearful of experiencing air pollution problems similar to those of Denver. Ridesharing programs, transit expansion, downtown parking policies and signal synchronization projects in the area are "sold" to some extent on their air quality benefits. These TSM measures are beneficial to both air quality and energy consumption, but their energy impacts have not been widely publicized.

The most significant activity undertaken in Colorado Springs related to energy consumption was the recent development of the Transportation Plan. Assumptions about the impacts of energy costs in the future were treated in two ways in the development of traffic networks. First it was assumed that costs of owning and operating an automobile would increase by 150% relative to the costs of goods and services, after controlling for inflation. This was estimated to reduce auto ownership to an average of 1.4 vehicles per household*, similar to the trends prevailing in the 1970's. Secondly, the costs were estimated to increase transit ridership, and the impacts resulted in a 2% decrease in VMT.

The Plan analyzed three different scenarios for future growth in the region, as well as some combination of other factors within each category. The "most probable" scenario assumed a continuation of the region's 2-3% growth rate; the "do nothing" scenario, and the "activity center" scenario assumed that the 2-3% growth per year would be channelled into 11 high density, nodal, development centers. The activity center approach was developed as an attempt to show the benefits of high density, concentrated growth on transit use, air quality, reduced VMT and reduced energy usage.

---

*Auto ownership in the area is now 1.7, and would otherwise be predicted to rise to 1.9.

The energy consumption impacts of the three roadway systems were calculated. The activity center alternative registered a 10% reduction in energy consumption over the most probable, assuming that all of the development was indeed channelled into these areas. Although the activity center showed some benefits in most of the appropriate areas, the transportation planners were disappointed that the differences were not even more dramatic; given the amount of non-transportation changes that would need to be justified to enact such a system.

The conclusion reached by the MPO was that improvements associated with the most probable system should be planned for, as the most appropriate scenario for the next two decades; particularly regarding the economic costs associated with all alternatives.

The COG staff believes that an energy consumption component of network alternatives should be included as one element of analysis, but it would be extremely difficult to sell any one alternative, program or project primarily because of its energy implications. Generally, it was felt that the MPO role could be more useful in terms of public education. It was believed that VMT in the area is highly related to personal income, and the income level of residents is rising considerably. A very large number of area residents drive campers, pick-ups and/or recreational vehicles, making strategies designed to reduce household travel particularly difficult to implement. It was felt that energy impacts should be looked at just as air qulity, economic impacts, etc. in analyzing a project or program, but could not be sold on its merits alone, nor necessarily should be. Given an area with rising incomes, rapid growth, significant recreational travel, and somewhat conservative beliefs, emphasis placed on measures which make existing travel more efficient are likely to be more cost-effective than measures designed to alter travel behavior. This is true given the existing public perception about energy use. It may, however, be an important public sector activity to continue to provide public education services which over time will begin to change public perception. At that time, other strategies may begin to become more realistic to implement.

Jacksonville, Florida

The Jacksonville urban area is located in the extreme northeastern section of the State of Florida, adjacent to the Georgia border and bounded by the Atlantic Ocean on the east. It is the largest metropolitan area in north Florida, and fourth largest in the State. The area is characterized by flat open land, with the St. Johns River slicing through downtown, and agricultural areas on the outskirts of the metropolitan area. There is a strong naval presence in the City, with three large naval bases located within its borders. The City has, in recent years, consolidated with adjacent municipalities to the point where its 840 square miles make it the largest single municipality in the country. The urban area encompasses all of Duval County and the northern portions of the adjoining Clay and St. Johns Counties.

The Jacksonville area has been experiencing a moderate growth rate in the past two decades, but certainly nothing as rapid as other areas in Florida such as Tampa Bay or Orlando. The area grew between 1960 and 1970 by approximately 16%, but slowed during the 1970's to an 8% increase (1970 - 528,000; 1980 - 571,000).

Population projections made in the early seventies indicated a much more rapid population growth, with an anticipated 2005 population of nearly 1,000,000. Estimates of the 1980 population were over 100,000 persons higher than the actual total. New population projections based on the actual 1970-1980 growth rate is currently being undertaken.

MPO Structure

The Metropolitan Planning Organization in the Jacksonville area is the Jacksonville Urban Area Transportation Study (JUATS). JORTS is composed of the City of Jacksonville, which has six voting members, the Transit Authority, which has one member, and one member from each of the counties. The City of Jacksonville Planning Department acts as the staff of the MPO and has a six member transportation division. The MPO has a Technical Coordinating Committee and a Citizens Advisory Committee. The Mayor of Jacksonville is the Chairman of the Metropolitan Planning Organization.

Traffic Network Characteristics

The travel patterns in the Jacksonville area indicate a dispersed travel network. Recent growth has not been CBD oriented, but oriented toward suburban areas. The St. Johns

River physically divides the western area with the Central Business District, and the river crossings are the major congestion problems in the city. Other than the bridges, there are congestion problems encountered on a number of arterials with problem intersections, most of which are in growth corridors outside the CBD, and with at-grade railroad crossings. The daily VMT is estimated to be about 8,000,000, with slightly over 1.5 million person trips per day. Estimates based on previous population projections indicate that by the year 2005, person trip will increase by 68% to over 2.5 million per day.

A major transportation concern within the region are river crossings, with support to improve their efficiency and/or provide additional crossings. Recently, two bridges were converted into one-way pairs, and this has resulted in noticeable traffic flow improvements. One totally new crossing is listed on the Transportation Improvement Program. An additional major improvement that has previously been recommended has been a downtown people mover limited rapid rail line, proposed to reduce ADT and promote transit usage.

At the present time disincentives for automobile use into the CBD do not exist. Tolls on the bridges are 25¢ each way, with two of the bridges free of charge. There is a discount for frequent bridge users via discount books which reduce the amount of the toll to $.15. Parking in the CBD is extremely inexpensive, averaging about $1.30 for all day parking, and the supply is adequate.

Transit

Transit service is provided by the Jacksonville Transportation Authority. The system currently averages 54,000 weekday riders, although ridership has dropped somewhat as a result of fare increases and service cutbacks. The basic fare after a recent fare increase is 60¢. It is becoming increasingly more difficult for the transit system to attract non-captive riders for a number of reasons. Given the cost of driving into the CBD and the low cost and ease of parking, transit use does not provide a more attractive package. Secondly, with growth and development spreading across the area, the system's routes do not serve a significant portion of the public's travel patterns, and there is no evening or Sunday service. The system currently serves approximately 3.5 percent of total weekday trips. The Comprehensive Transportation Plan has recommended an extensive expansion of the transit system, including the construction of the fixed guideway system of 19.3 miles, the acquisition of 200-250 new buses and 4,000 park and ride vehicle spaces. It was estimated that this would increase mass transit usage fourfold to over 200,000 daily trips. However, the costs involved ranged

from $434-529 million in 1980 dollars, with an annual escalation in the vicinity of $40-60 million. The feasibility of expanding such costs now appear low.

Traffic Modelling and Forecasting

The Jacksonville Planning Department does not presently have any in-house computer or modelling capability. The staff did provide the data that was fed into the UTPS and UROAD forecasting networks, but the actual modelling was done by the Florida Department of Transportation and its consultants. The air quality modelling that was necessary in order to assess control strategies was done privately as well, including the energy impact component of the analysis.

Surveillance

The surveillance activities that are conducted are primarily those necessary as input into the traffic forecasting network. A traffic counting program is set up utilizing city engineering staff, and vehicle occupancy and travel delay studies are concentrated on the heavily congested river crossings. No fuel consumption monitoring or other energy related monitoring efforts are conducted.

Work was undertaken as part of the comprehensive planning process on assessing transit service and travel characteristics through a citizen survey. The results of this effort indicated that approximately 18% of commuting trips are done in carpools and 16.5% by transit.

Energy Conservation Activities

The conservation of energy in the transportation section is not a major concern in the Jacksonville area. The staff of the MPO has undertaken a number of activities to either encourage it as a goal or analyze energy consumption, but these are not major efforts. A number of factors operating within the area inhibit the ability to pursue measures that will result in reduced energy consumption. Other than the river crossings, there is little overall traffic congestion in the area. There is also very little incentive to consider reduced automobile usage, particularly coming into the downtown, where alternative modes are most accessible. Daily parking rates in municipal facilities in the downtown area are extremely low ($1.50/day), and therefore private facilities have kept their rates low as well. It is therefore much easier to drive downtown alone than to take public transit or to participate in a carpool. The area was awarded a TSM grant to develop a demonstration program on the Matthews Bridge corridor that would encourage ridesharing by providing HOV

lanes, park 'n ride facilities, and transit transfers, but for various administrative reasons, this program is unlikely to be carried out.

The area was affected somewhat in the 1979 energy crisis, although residential price increases were more dramatically felt. The area was, however, impacted heavily during the 1973 embargo and that generated substantial support at the time for energy conservation measures.

The area does have a moderately effective ridesharing program, operated jointly by the MPO staff and the Mayor's Energy Office. The program is largely employer based and serves primarily downtown offices. It has been estimated that the annual energy savings resulting from the program amount to nearly 663,000 gallons of fuel based on a 10,000,000 reduction in yearly VMT.

Most of the energy consumption analysis that has been done is a result of the analysis of TSM measures conducted as part of the air quality program. This was carried out by a private consultant, and included an estimate of the reduction in gallons of fuel conserved based on the potential VMT reduction of the air quality control measure. Measures recommended under this program included a continuation and expansion of the ridesharing program, a new fleet of transit vehicles, pre-emptive signal devices on major arterials for buses, the downtown people mover system and a downtown pedestrian mall.

Another activity that was undertaken by the MPO staff regarding energy consumption concerned the Transportation Improvement Program. For a perid of years,the TIP contained a category which qualitatively listed each project's potential impact on air quality and energy conservation. The assessment was a qualitative one, not based on technical analysis and impacts were characterized as "none, minor or significant". This attempt came under criticism on a number of fronts, mostly based on the vagueness of the system and the inability to discern in what direction the impacts would occur. In addition, those projects with significant air quality/energy benefits were not necessarily ranked as high priority projects, and this came under EPA's scrutiny. The system was dropped last year, and the MPO plans to replace this with an assessment category that can more accurately assess the impacts. The ability to do this at the staff level is not available at the present time, however, and the system won't be reintroduced until appropriate methodologies exist.

The other major energy impact analysis was contained within the Jacksonville Year 2000 Transportation Plan. The plan

analyzed three different networks suggesting different levels and types of transportation improvements, and somewhat different development patterns. The travel forecasting and analysis of the various transportation test networks were conducted by the Florida DOT and its consultants. The modelling effort produced an estimation of each test networks' vehicle pollutants emitted and the daily fuel usage. The estimate assumes an average mix of auto and trucks, and approximate effects of grades, curves, stops and speed change cycles were incorporated. Fuel consumption rates for various speeds and facility types were taken from the U.S. Department of Transportation report "Characteristics of Urban Transportation Systems", May 1974.

ESTIMATED YEAR 2005 FUEL
CONSUMPTION-HIGHWAY SYSTEM

Daily Fuel	Test I	Test II	Test III
Used (gallons)	1,362,800	1,367,200	1,336,000
	(100.0 base)	(100.3)	(98.0)

These results indicate that there was little different in the three networks, with the Test III network, the one ultimately recommended, indicating a 2% reduction in energy consumption over the other two networks. Interestingly, the Test III network had the least extensive rapid rail system and concentrated more of the efforts on express buses, operational improvements and river crossing capacity. The energy factors were not a significant factor in reaching an ultimate decision on a recommended network.

The JPD believes that in the Jacksonville area, it is difficult to promote energy conservation techniques unless adequate disincentives are in place for single occupancy vehicle trips. Gasoline price by itself is not a strong enough disincentive in Jacksonville. The city has had an outside consultant to review its downtown parking rate structure and the results of this, if implemented, may provide some disincentive. It was also believed that the promotion of ridesharing is an appropriate continued role of the MPO, as a cost-effective means of individual energy conservation.

However, it seems clear to the MPO staff that energy conservation cannot be a high priority work program unless one of two things happen. Either there has to be a strong level of public support from city leaders for the need to analyze energy conservation; that is, to suggest it as a high local priority.

Albuquerque, New Mexico

Regional Characteristics

The Albuquerque urbanized area is by far the largest metropolitan area in the State of New Mexico. It is an area that has been growing rapidly in the past decade, and is expecting this level of growth to continue through the end of this century. It is located in a mile high plateau area towards the middle of the State. The Sandia mountains and publicly owned land limit the area's expansion to the east, but heavy growth is expected across the Rio Grande River in the north and western quadrants.

The 1980 U.S. Census listed the urbanized area as containing approximately 420,000 persons, an increase of 40% over its 1970 figure. Projections indicate that the area will almost double in size to approximately 800,000 persons by the year 2000. The recent growth has tended to be spread out in a sprawl pattern, with a density of approximately 2,000 persons per square mile.

The area contains a major U.S. Air Force base in its southeastern quadrant, and has been experiencing recent growth in high technology industry. Although the State Capital is Santa Fe, located to the northeast, the Albuquerque area remains the major commercial, business and residential center of the State. The 1980 Census has identified two new MPOs in New Mexico, the Las Cruces and Santa Fe areas; until that time Albuquerque was the only MPO within New Mexico.

MPO Structure

The designated Metropolitan Planning Organization in the Albuquerque area is the Middle Rio Grande Council of Governments of New Mexico, a multi-jurisdictional board composed of five counties and fifteen municipalities. The Urban Transportation Policy Board, composed of those areas within the urbanized area, act officially as the MPO. The Policy Board is composed of representatives of the following jurisdictions: City of Albuquerque, Village of Tijeros, Village of Corrales; Bernalillo County, Sandoval County, Albuquerque Public Schools, Albuquerque Metropolitan Arroyo Flood Control Authority, City of Rio Rancho, Village of Los Ranchos de Albuquerque; members of State and Federal transportation agencies act as advisory non-voting board members.

The Council of Governments acts as the primary staff to the MPO. The COG transportation staff contains approximately 5-6 people (total COG staff is 30), and is oriented towards a systems analysis approach to transportation planning. It relies heavily

on computer assisted modelling and planning methodologies, and has 2-3 full-time computer programmers within its staff, with one person devoted full-time to transportation related programming.

Traffic Network Characteristics

The area is characterized by extremely dispersed travel patterns, as a result of its recent growth patterns. Average daily traffic is approximately 7,000,000 miles, and VMT has been increasing approximately 4% per year. The most serious traffic problems concern the crossings over the Rio Grande, as development pressures are increasing in the area west and northwest over the river. These areas are becoming residentially developed, and their work trips are taking them across the river to the Central Business District, the University of New Mexico, the "uptown" commercial area, and the Air Force base.

The downtown area is laid out in a grid system with one way paired streets. There is no serious congestion or parking problems in the CBD area. Traffic congestion is more of a problem in the uptown area, an area east of the CBD with two large-scale regional shopping malls and increased office development. The existing roadway network in this area is overtaxed and needs increases in capacity. The vehicle occupancy rate for the work trip in the urbanized area is approximately 1.2 persons per vehicle.

Transit

Transit service is provided within the city limits by SUNTRAN, a city-owned system of 80 buses, with an additional 25 vehicles currently on order. The system operates on a grid system at the present time, previously operating in a radial pattern from the downtown area. The system carries approximately 23,400 average weekday boardings; with peaks in the 7:00-7:30 A.M. period, and the 3:00-3:30 P.M. period, reflecting the large number of school-age riders (34%). Over 40% of the riders are destined for either the University area, downtown, the uptown area, and the Air Force base. Approximately one-quarter of the riders are those without access to an automobile. The base fare is 50 cents, with student, elderly and handicapped and monthly discounts available. Ridership has been increasing in recent years.

Until recently, SUNTRAN did not have a staff assigned for short range transit planning, and the COG did the long range planning. Recently, COG has funded a person to work out of the SUNTRAN office to conduct short range transit planning.

Transportation Modelling and Forecasting

The COG staff is heavily oriented towards a systems planning approach to transportation planning for the region. It utilizes the UTPS process, and is currently in the process of validating its model. It is using the city's IBM 370 system with virtually unlimited accessibility. It also has a microcomputer which it intends to use for sketch planning techniques. It utilizes sketch planning procedures at the current time for sub-area work or in other areas where it is more appropriate than UTPS. It has a full-time transportation programmer, and has two other programmers available on staff for use when needed. Its air quality analytical work was conducted by utilizing Mobile II.

The COG also maintains UTPIS, the Urban Transportation Planning Information System, as a file for all of its information and data. It is utilizing TRANSURV to calculate VMT within the area, and is currently developing a transit patronage modelling procedure. It maintains a current Geographic Base File system as well.

Surveillance

The COG maintains a very extensive data base, to serve as input to UTPS and its various planning activities. Its data includes information from motor vehicle department records regarding fleet characteristics, auto ownership, etc. It also maintains transportation information from the school system, from State records and through its base file. The COG maintains an active file of roadway segment characteristics, subdivision plans, etc. The COG compiles traffic counts by City and State agencies, and conducts the HPMS for the State Department of Transportation. It conducts vehicle occupancy and travel delay studies on an ongoing, area-by-area program.

The COG has considered maintaining a file on fuel consumption within the area, as it would be available through tax records and State agencies, but has determined that such an effort would be too expensive given its potential usefulness.

State Activities

The New Mexico Highway Department has a somewhat different relationship with the Albuquerque MPO in New Mexico than is common in other areas. Since Albuquerque (until recently) was the only urbanized area in the State, the New Mexico State Highway Department has traditionally allowed the MPO to take care of most transportation matters within the metropolitan area, and has itself concentrated on rural roadway matters. In some cases, the COG under contract to the State Highway Department performs certain functions on its behalf.

In terms of energy, after 1979 the State mandated that all State agencies reduce gasoline consumption by 10%. Additionally, the State Department of Energy and Minerals was given responsibility as the lead agency for the 1979 Energy Plan, which looked at twelve limited measures to reduce energy, but was never carried through to its implementation stage.

Energy Conservation Activities

Albuquerque has been active conserving residental energy use, and has been in the forefront of solar access legislation. The City's General Plan has recently had proposed a revision to it that would include a set of energy conservation policies, including those relating to transportation energy. The city has an Energy Office, which deals with a wide spectrum of energy matters.

In terms of transportation energy, the city has mandated that all departments reduce their energy consumption, mostly through more efficient use of its fleet vehicles. It has also beeen investigating the possibility of fuel conversions of city vehicles, looking at propane and gasohol as well as diesel.

Although there is some degree of interest in energy conservation, gasoline consumption has never been a major issue. There is considerable oil refining and distribution nearby, so that availability and price tend to be better than other areas of the country. The 1979 gasoline crisis did not hit the area very hard. Some stations limited their hours of service, but there were no gas lines or shortages. The situation did serve, however, to heighten people's awareness of a problem, and VMT growth did slow somewhat immediately after the "crisis" situation.

The COG, acting as the MPO, has taken the lead role in energy conservation in the area. It has been coordinating the Transportation Energy Conservation Planning Study, which includes both contingency and conservation strategies, as it is believed that these two areas cannot be clearly distinguished from one another. The study outlines a number of recommended energy conservation measures (ECMs) that should be initiated and/or put into a state of readiness in the event that the Governor declared either an energy alert or energy emergency.

The COG has incorporated energy conservation into its transportation planning process in a number of ways. First, it has developed an estimated gas consumption basis for the county between 1980 and 1991. Secondly, as part of its analysis of air quality transportation control measures, it has included an indication of the potential energy impacts, based on reductions

in VMT, and the estimated average fuel efficiency of the automobile fleet at the time of implementation. This has resulted in ane estimate of energy savings associated with each recommended TCM that reduces VMT. These savings ranged from 0.04% - 4.6% of total energy use.

Additionally, the COG looked at conversion of all fleet vehicles to propane fuel and determined that the savings would be substantial: 20,000,000 gallons of fuel or 8.6% of total consumption.

The methodology utilized in the air quality analysis only estimated fuel consumption on the basis of reduced VMT. Thus, measures which improve vehicle speeds, such as signal synchronization, were not analyzed in terms of energy, even though these measures were believed to be highly beneficial.

The COG has occasionally conducted an energy impact analysis on TIP projects, most recently in the River Crossing Corridor analysis. For most projects, any energy impact assessment is likely to be qualitative. The COG has identified one-third of the projects on the TIP as having air quality and energy conservation benefits.

The COG's UTPS program is not completely validated at this point, so it cannot as yet estimate fuel consumption impacts of various network alternatives.

Akron, Ohio

The Akron, Ohio urbanized area covers a three county area located in northeastern Ohio, centrally located within a relatively short distance to three other urbanized areas: Cleveland, Canton, and Youngstown. The central City of Akron (population 237,000) has historically been an industrial center, noted as the home of the U.S. rubber industry, which has been changing its base in recent years into an office and service center. The region is served by an extensive regional interstate and State highway system, connecting Akron to these nearby areas as well as providing it with substantial through traffic movements.

The urbanized area population is 495,000, down in size approximately 5% since 1970, while the City of Akron has declined in size by over 16% during the last decade, the overall SMSA declined only by slightly over 27%, indicating a redistribution trend towards the suburban or less developed portion of the area:

	SMSA Population	% Change	City of Akron Population	% Change
1970	679,000		275,000	
1980	660,000	-2.8%	237,000	-13.08%

Population forecasts made before the 1980 Census indicated a year 2000 SMSA population of slightly over 800,000, but these projections now are considered high; they are scheduled to be revised shortly.

MPO Structure

The Akron Urbanized Area covers Portage and Summit Counties and a small potion of Wayne County. The MPO for the area is the Akron Metropolitan Area Transportation Study (AMATS), represented by officials of the 3 Counties; 32 municipalities, 2 transit authorities, and the Ohio Department of Transportation.

Transportation Network Characteristics

The Akron area exhibits a fairly dispersed travel pattern. While the Akron CBD, as well as the smaller cities, remain strong traffic generators, there is also considerable travel originating from scattered suburban residential areas and destined for suburban based generators, inter-urban travel (Cleveland is only 35 miles to the north), and through traffic which utilizes the area's extensive highway system. The daily VMT estimate of 13,000,000 (2,000,000 ADT) is the highest of any of the areas

studied. Projected VMT based on the existing population projection is 17,000,000 by the year 2000, which is less than a 2% increase per year. Peak hour congestion problems are experienced to some degree on selected highways leading into the CBD, partially caused by outdated design. Other congested areas relate primarily to intersections and arterial problems, and are not primarily CBD related. Movement within the CBD is not particularly constrained, and all day parking is relatively inexpensive. There are some concentrations of employment and commercial activitiy in suburban areas, and in some cases the existing roadway capacity is insufficient. Overall congestion problems, especially when compared to larger urban areas, are not overly serious. There is little support for major new roadways or capacity expansion, with most transportation improvement activities more related to traffic flow improvements.

Average travel time for work trips is estimated to be 15.64 minutes, with an average travel distance of 8.94 miles. Major generators include Kent State University, Akron University, the Goodyear Aerospace Center, and a number of large rubber industry employment centers.

Transit

The area is served by two regional transit authorities. One is the Metro Regional Transit Authority, which serves Akron, Cuyahaga Falls, and Barbertown, and provides services under contract to Fairlawn and Stow; and the Portage Area Regional Transportation Authority (PARTA), which is composed of Kent, Ravenna, Brady Lake, Franklin and Ravenna Townships. Transit service for PARTA is provided, under contract, by the Kent State University Campus Bus Service. The service is focused in Kent and most heavily used by University students. The Metro RTA service carries approximately 21,000 daily riders, with a basic fare that is about to be raised from \$.55 to \$.60. Although the system experienced a slight increase in ridership for a short time during the 1979 energy crisis, the ridership levels have been steadily declining for the past few years. The PARTA service is more University oriented and thus its riderhip levels have been more stable, and it currently carries approximately 10,000 riders per day.

Surveillance

The AMATS staff conducts a fairly extensive data collection and surveillance effort, as part of the maintenance of its forecasting and modelling capability. These efforts include intersection data, traffic counts, transit ridership, average speeds and delays, etc. Average work trip auto occupancy is 1.26, with an overall average auto occupancy of 1.44.

Traffic Modelling and Forecasting

The AMATS maintains a full operational UTPS travel forecasting network. This actually is a joint effort between the AMATS staff and the Ohio Department of Transportation. The trip generation factors are developed at the AMATS staff level, and this information is sent to ODOT for trip distribution and traffic assignment. The AMATS staff has control over the data inputs that the model is dependent upon. The model is used for the analysis of transportation system alternatives as part of the long range planning efforts. The non-transportation inputs into the model remain constant across the alternate networks. That is, adjustments based on future energy scenarios and/or land use changes were not input; only the transportation systems to serve the anticipated travel trends were altered. An energy consumption analysis was developed as an output, but the differences were insignificant, as VMT did not vary greatly among the various networks.

Energy Related Activities

The Akron area does not appear to consider energy conservation in the transportation sector a high priority concern. While there were some gasoline lines and station closings in the summer of 1979, the area did not consider this a crisis situation, as no real shortages appeared. Some increase in transit ridership was seen, but this was short lived. There was not particularly significant demand placed on the ridership program either.

Given the magnitude of the regional highway network, there is little discussion of major new facilities. Combined with the fact that most of the congestion problems were focused on intersections and local streets, most of the transportation planning efforts in the area are centered on traffic flow improvements. These types of measures tend to be generally beneficial in terms of energy consumption, and therefore a major "special" effort to develop energy conservation measures is not seen as a high priority. In particular instances where it is believed that a project will have beneficial impacts, energy consumption analyses were conducted, primarly based on improved travel speeds. Estimates of fuel savings of VMT reduction programs, such as carpooling, are done as well to indicate their benefit. Long term transportation network alternatives are analyzed as to their consumption impacts.

The major AMATS efforts in this regard is the "Energy Considerations in Transportation Planning" document (September, 1980) and the area's Energy Contingency Plan. These documents were done as a response to Federal guidelines that energy

contingency and conservation plans be developed at the MPO level. The Contingency Plan is seen as a very important document to have developed and kept updated, as the area's transit systems do not have the capacity to accommodate the demand that an energy shortage would generate, and other action programs must be made ready for such an occurrence.

The "Energy Conservation" report was developed as a method to build upon the work that was done as part of the Contingency Plan analysis as well as to indicate how energy conservation concerns are being incorporated into the overall process. Although the Contingency Plan is the only effort that has been made specifically for energy purposes, this other work effort documents the fact that certain goals and objectives, certain TSM measures, and certain other ongoing AMATS work activities do indeed have the effect of encouraging and assisting in the implementation of strategies that have, as one of their benefits, positive energy conservation impacts.

Eugene, Oregon

Regional Characteristics

The Eugene-Springfield urbanized area is the second largest metropolitan area in the State of Oregon, located approximately 100 miles south of Portland, the State's largest area. The area is heavily oriented towards logging and the wood products industry, which is currently feeling the impacts of the county's economic problems. The County contains two major cities. Eugene is the larger city, with a population of 120,000, and is also the home of the University of Oregon, which is the city's largest employer. It also is the office and commercial center of the county. Springfield is a smaller city (population 41,000), located adjacent to Eugene.

Lane County is the smallest MPO studied in this project, with an urbanized area population of approximately 185,000. The area's growth has stabilized recently as a result of economic conditions, after a fairly rapid growth pattern during the 1960's and 1970's. (The area's population increased by 31% between 1970 and 1980). Lane County covers an extremely large geographic area of over 4,600 square miles, running from the mountains (to the east) to the ocean (on its western border). The urbanized area, however, is concentrated into an 81 square mile area surrounding Eugene and Springfield.

MPO Structure

The Lane Council of Governments (LCOG), a group of local elected officials established for long range planning, has been designated as the Metropolitan Planning Organization for the area. The policy body for the MPO is a sub-group called the Metropolitan Area Transportation Committee (MATC) representing the urban area of the county. Its membership is composed of elected officials or their alternates who set and review policy direction for transportation planning and implementation in the metropolitan area. The MPO also has a Transportation Planning Committee (TPC) composed of the staff of various local agencies, the Oregon Department of Transportation, and the Federal Highway Administration, which serves as its technical committee, as well as a Citizen's Advisory Committee (CAC).

The Lane Council of Government acts as the principal staff to the MPO, and has a two person transportation department. The Cities of Eugene and Springfield each have their own planning and transportation staff, as does Lane County. The Lane Transit District and the Oregon Department of Transportation also provide professional transportation services within the urbanized area.

Transportation Network

The transportation network within the urbanized area does not appear to experience significant congestion problems. Some peak hour congestion problems appear in the afternoon peak hours in and around the Eugene CBD, but usually dissipate in 15 or 20 minutes. The University of Oregon is a major traffic generator, and parking and traffic conflicts with adjacent residential neighborhoods do occur. The Long Range Transportation Plan identifies five corridors where serious congestion problems, vehicle overloads and capacity deficiencies can be expected by the year 2000 if no improvements are undertaken. It also identifies a number of other smaller scale projects that should be implemented in order to improve existing and anticipated problems.

Since the size of the urbanized area is relatively small, the average travel time and travel distance in the area is small as well, with average travel distance for work trips approximately 4.25 miles and average travel time approximately 15 minutes. The figures are likely to remain fairly low as long as the Urban Growth Boundary System is kept in effect in the State of Oregon. This system mandates that all future growth and services, if possible, remain within a boundary limitation delineated by the local community. Although there has been development outside the central city, most specifically the Valley River Center, a regional shopping and office complex a few miles from the Eugene CBD, the distances remain somewhat compact overall.

One additional viable mode of transportation in the area is the bicycle. Given short distances, temperate weather, a large University related population, and a populace concerned with "liveability", the bicycle in this area is utilized significantly for transportation. The municipalities have responded to this by providing a substantial system of bicycle facilities and plans to further expand the system.

Since the area is presently suffering from high unemployment, it is strongly tempting to attract new economic development activities, and towards this end are considering further roadway network expansions as a means of attracting such activities.

In recent years, the area has been experiencing a decrease in VMT. This has been attributed more to stabilized growth and unemployment than anything else, but it did begin to decrease after the 1979 energy crisis, even though the area was not heavily impacted. Total DVMT is slightly over 2,000,000 miles per day.

Surveillance

The LCOG gathers fairly standard data that is necessary as input into UTPS. In terms of energy data, it utilized State estimates on fleet characteristics for its air quality work. The fuel consumption estimates are made on a Statewide basis, and it has proven infeasible to accurately monitor fuel consumption within the metropolitan area. Overall fuel consumption has been decreasing Statewide since 1976.

Energy Related Activities

The Eugene-Springfield area is generally supportive of energy conservation policies, goals and objectives. The area is conscious of the need to conserve energy, mostly as an outgrowth of the overall environmental movement that flourished in the area in the seventies. The situation was further heightened during the oil embargo of 1973, which impacted the area very heavily. Gas lines were serious at that time, and there was a surge in transit ridership and alternative modes as a result. In the 1979 crisis, however, there was limited impact, with little panic buying and no serious lines seen.

The City Council of Oregon has in its official policies and goals a number of items supportive of energy conservation. There is a more heavy emphasis on residential energy use, since most of the homes are totally electric and prices have increased substantially. The Council has, as mentioned, adopted goals supportive of transit usage, provided extensive bicycle facilities, and adopted downtown parking policies which generally support energy goals in the transportation section. Although energy conservation may not have been the major impetus for their implementation, nonetheless they do provide some degree of supportiveness at least in terms of consequences.

The downtown parking policies are particularly interesting in Eugene. The city has funded and constructed a number of new parking facilities, both surface and garage lots. Most of these are free of charge, but reserved for short-term shoppers. Downtown employees have designated lots where monthly passes are sold, averaging $26.00 per month. Vehicles which carry 3 or more people on a day to day basis are sold passes at reduced rates.

It is believed that these policies will make downtown shopping more attractive and at the same time encourage carpooling and use of transit for work related trips. The City has been under criticism from employers downtown for these policies, and was heavily critized recently when it tried to raise monthly fees, with threats of moving out of the downtown area because of the parking situation. Whether the City remains

Surveillance

The LCOG gathers fairly standard data that is necessary as input into UTPS. In terms of energy data, it utilized State estimates on fleet characteristics for its air quality work. The fuel consumption estimates are made on a Statewide basis, and it has proven infeasible to accurately monitor fuel consumption within the metropolitan area. Overall fuel consumption has been decreasing Statewide since 1976.

Energy Related Activities

The Eugene-Springfield area is generally supportive of energy conservation policies, goals and objectives. The area is conscious of the need to conserve energy, mostly as an outgrowth of the overall environmental movement that flourished in the area in the seventies. The situation was further heightened during the oil embargo of 1973, which impacted the area very heavily. Gas lines were serious at that time, and there was a surge in transit ridership and alternative modes as a result. In the 1979 crisis, however, there was limited impact, with little panic buying and no serious lines seen.

The City Council of Oregon has in its official policies and goals a number of items supportive of energy conservation. There is a more heavy emphasis on residential energy use, since most of the homes are totally electric and prices have increased substantially. The Council has, as mentioned, adopted goals supportive of transit usage, provided extensive bicycle facilities, and adopted downtown parking policies which generally support energy goals in the transportation section. Although energy conservation may not have been the major impetus for their implementation, they nonetheless they do provide some degree of supportiveness at least in terms of consequences.

The downtown parking policies are particularly interesting in Eugene. The city has funded and constructed a number of new parking facilities, both surface and garage lots. Most of these are free of charge, but reserved for short-term shoppers. Downtown employees have designated lots where monthly passes are sold, averaging $26.00 per month. Vehicles which carry 3 or more people on a day to day basis are sold passes at reduced rates.

It is believed that these policies will make downtown shopping more attractive and at the same time encourage carpooling and use of transit for work related trips. The City has been under criticism from employers downtown for these policies, and was heavily critized recently when it tried to raise monthly fees, with threats of moving out of the downtown area because of the parking situation. Whether the City remains

loyal to the policies in light of economic difficulties remains to be seen.

It is interesting that of the corridors forecasted for congestion by the year 2000, only the downtown Eugene area shows potential for alleviating these conditions through a greater switch to other modes.

The MPO activities have stressed the need for energy conservation in a number of ways. Their overall goals and objectives, both in the General Plan and the Transportation Plan, state the need for more compact development and higher densities, consistent with Urban Growth Boundary policies. These land use patterns would have the greatest impact on overall energy consumption.

The most direct activity related to transportation energy conservation was the development of the Transportation Energy Conservation Plan by LCOG staff in 1980. This effort was a staff initiated attempt to put together all other goals and policies which impact energy consumption and develop a specific set of policies related specifically to energy consumption. This effort was based on the staff's beliefs that long-term dependence on petroleum at the same level as exists today will ultimately result in serious local, as well as national, problems. Since many of the area's transportation policies do in fact have energy implications, they should be expressly stated in relation to energy, rather than other, usually complementary, goals.

The Conservation Plan served a number of purposes. It explained the need to conserve energy and listed major goals and objectives that transportation and energy policies should address.

The LCOG Plan lists a number of diverse policies and their implementation actions which maybe could affect future fuel consumption. Policies deal with, among other things, taxing policies, land use policies, funding allocations and priorities; parking policies, and enforcement procedures.

The final sections of the Plan denote those policies in the Transportation Plan and the General Plan that are consistent with energy conservation.

The Transportation Energy Conservation Plan was an attempt by the MPO staff to develop long-term proposals which will deal with energy conservation on an ongoing basis. It was not a technical analysis of various techniques, although their impacts were carefully assessed qualitatively and by utilizing research done by others.

Although supported at a staff level, the Policy Committee of the MPO was not enthusiastic about its development or adoption. Some members believed that such a wide ranging effort was not appropriate for the COG to undertake. This emphasized the fact that energy use is still not seen as a "normal" function of the MPO's work.

While the adoption of this overall effort was not successful, the MPO staff believe that support for TSM improvements which assist in better operational flows of the roadway network and encouragement for ridesharing and transit use are still strong. The staff is interested in determining as an additional factor for support the energy impacts of traffic flow improvements, but do not as yet have the capability to do so. A Signal Synchronization Improvement Study is currently underway, and is expected to have beneficial energy impacts. It also believes that Eugene is one area where bicycle use can have more than a trivial impact on energy consumption.

Overall, there was a belief that the MPO's best efforts related to energy conservation should be concentrated on long range transportation plans; once the ability to determine areawide energy consumption for a particular network is developed, then its energy impacts could become an integral part of the plan and one component of policies adopted as a result of a desired future.

Lehigh Valley, Pennsylvania

The Lehigh Valley urbanized area is one of a number of mid-sized areas located in Pennsylvania. The area is a multi-nucleated area covering three principal cities (Allentown, Bethlehem and Easton), and a number of smaller communities. The Town of Phillipsburg and a number of surrounding communities are also included in a separate urban area. The area is located in northeastern Pennsylvania adjacent to the New Jersey border. It is an older area characterized historically by industrial mill development in and adjacent to its cities and primarily agricultural land in the remainder of the counties. Recent years have seen loss of a portion of the industrial base, with some newer economic development activities, and conversion of agricultural areas to suburban development. The urbanized area covers approximately 130 of the 730 square miles of Lehigh and Northampton Counties.

The 1980 population of the urbanized area is 381,734. This represents a modest 5% growth over its 1970 population, and 15% higher than 1960. It is anticipated that the area will grow even more slowly in the 1980's than it did in the 1970's. However, as is true elsewhere, the number of households are growing, and VMT increases and increases in automobile ownership are expected to grow substantially in spite of the stability of the overall population totals.

MPO Structure

The responsibility for transportation planning in the area is that of the Lehigh Valley Transportation Study, a cooperative agreement of the counties of Northampton and Lehigh, the cities of Allentown, Bethlehem and Easton, and the Pennslyvania Department of Transportation, each of which has equal voting membership. In addition, the Phillipsburg Urban Area Transportation Study was separately formed under a similar arrangement, covering Phillipsburg Town, Alpha Borough, Lopatcong Township, Pohatsong Township, Warren County and the New Jersey Department of Transportation.

The major staff resources for both of the MPOs are provided through the Joint Planning Commission of Lehigh and Northampton Counties. The Commission has a transportation planning budget of approximately $163,000 and employs four full-time staff persons in their transportation planning section.

Transportation Network Characteristics

The existence of three "central" cities in the urban area, and an additional one in the Phillipsburg area, means that travel patterns tend to be somewhat dispersed. The downtown areas of each of the cities still act as major travel destinations, but their importance as a total percentage of all trips is declining. Most of the new industrial, retail and residential growth occurring in the area is being located in suburban areas, and many trips are now bypassing the central city areas. The existing roadway network is primarily set up to accommodate east/west travel movements, as the cites are oriented in these directions. New residential areas, however, tend to be located north and south of this axis, where the existing system is not as well developed.

The area has been rather hard hit by the national economic difficulties, and this has shown up on a number of the traffic demographic and traffic indicators as well. Projections of population by 1980 and into the 1980's were much higher than recent trends suggest; the same is true for VMT growth. Auto ownership showed a decline the past two years after a long trend of continual increases, in some years much greater than the population increases. However, VMT figures for the past five years do indicate an annual growth rate of 3-4%.

In general, in spite of new development in suburban areas, the distances travelled for commuting purposes remain relatively short. Work trip distances average 4-5 miles and travel time averages approximately 15 minutes. Serious congestion problems are not evident, except in the Route 22 corridor, which is heavily utilized for both local and through trips. These through trips are significantly affected by trucks, which account for approximately 20% of daily traffic on Route 22, and 25% in peak hours. The trip distance for recreational based trips tends to be longer, as people are acclimated to driving longer distances to reach the recreational and cultural facilities in nearby states and large cities like Philadelphia and New York.

The major new roadway facility in developmental stage is the completion of I-78 through the area, which has been tied up in environmental reviews for the past decade. Sections are now moving forward to design. Its completion will reduce travel congestion on Route 22 by capturing much of the through traffic.

Transit

Transit service within the area is provided by the Lehigh and Northampton Transportation Authority (LANTA). LANTA operates

a fleet of 65 buses and provides service to 44 municipalities on 30 fixed routes. The base fare is 50¢ in peak, 40¢ during off-peak. Passenger ridership levels has increased substantially since the Authority was incorporated in 1972. However, the JPC has indicated that ridership in FY 1981 dropped approximately 5.8%. The most recent fare increase was put into effect in the first month of FY 1981.

The system carries mostly captive riders (80-90%). The typical LANTA riders do not utilize it on a daily basis, but rather use the system for relatively short shopping and work trips. LANTA does provide a number of "trippers", subsidized bus service within the two county areas to major employment areas, partially subsidized by area employers.

Travel Modelling and Forecasting

The JPC does not utilize computer assisted modelling or forecasting techniques in its transportation planning activities. Information of each type when necessary for a specific project or program is conducted by either the Pennsylvania Department of Transportation or by the use of private, outside consultants. The JPC does conduct its ridesharing program via a computer system, utilizing resources and computer availability at a nearby University. The program at one time also included all current transit route information, which would also be presented to potential ridesharers. This component was dropped from the program, as the route information changed too frequently to afford the constant program changes necessary to maintain an accurate program, and its usefulness was considered only marginal, particularly in light of reduced interest in the ridesharing program.

An outside consultant was hired to do the modelling for the air quality program, and utilized among other things the "TRANSYT 7" program to calculate the air quality impacts of changes to the transit system. This model also provided as output other impacts including energy consumption. The JPC is now considering whether it can retain the use of this modelling program on either facilities that are available through PennDOT or the local cities, or via a microcomputer. Staff is currently considering the purchase of a microcomputer.

Energy Conservation Activities

The staff of the JPC has been interested in pursuing energy conservation impacts as part of their transportation planning activities, but has found it difficult to do so at this point in time. Interest in energy has waned considerably in the area since 1979, when there was considerable interest in energy

conservation. The ridesharing program which was developed in response to the 1973 oil embargo and dropped later due to reduced interest levels, was revived in 1979. An effort to mobilize an employer based system was put into place, as individual matching was seen as not being cost-effective given the area's travel patterns. During the 1979 crisis, 11 new employers participated in the program, and some developed extremely high results, with up to 45% of employees in these companies ridesharing. However, by 1980, interest was again reduced and only one employer kept its program active.

With energy availability no longer a problem, the short travel times and distances, combined with a propensity to drive long distance in non-work trips and a high proportion of pick-ups and RVs, resulted in VMT growth rates at the pre-1979 levels; in some cases higher.

The JPC staff believe that energy conservation should continue to be an element in the transportation planning process, as shortages in the future appear inevitable. On the other hand, it is unlikely that people's travel behavior will change dramatically in a short period of time, so that efforts to conserve energy assuming continuation of current travel trends need to be analyzed as well. It is felt that all TSM work and sub-area or corridor analysis should consider energy implications, even if they are not decisive factors in project prioritization.

The consultants that conducted the air quality analysis also developed energy conservation impacts as part of the program. Those Reasonably Available Control Measures (RACMs) ultimately suggested for air quality improvements all had beneficial energy consumption impacts as well. The major projects included traffic signal coordination, increased ridesharing, staggered work hours, combination park 'n ride and express bus routes.

The energy analysis of these TSM measures varied depending upon their impacts, but were done using a fairly simple methodology. Traffic flow improvements which resulted in increased speeds were believed to result in improved average vehicle fuel efficiency. Ridesharing measures determined the amount of people shifting to carpools or buses, and multiplied the reduced VMT by an average MPG factor to determine energy savings.

In addition to the methodology utilized by the air quality work, the MPO has analyzed projects as to their energy savings under the methodology supplied by the Pennsylvania Energy Conservation, Congestion Reduction and Safety (ECONS) Program, which is a State program designed to provide funds for

small-scale traffic flow projects designed to result in a high cost benefit ratio for energy and safety projects. The elimination of 4-way stop signs is the first program that JPC has conducted under the ECONS guidelines.

The JPC is committed to including an energy impact assessment of all TSM projects that are analyzed, either from the air quality methodologies, the ECONS methodologies or a literature search of other appropriate methodologies.

It is also the belief of the JPC staff that the most significant means of conserving energy is to alter land use patterns to effectuate a denser pattern of development. Since Pennsylvania ended its capital improvement program for new roadway facilities or widenings in 1977, the burden to fund such improvements now falls on the municipalities. The JPC has suggested that municipalities consider the impacts of their land use policies and regulations on future roadway construction needs, in order to lessen capital costs in the future. Denser development would not only reduce roadway extensions, but also increase transit potential and conserve energy. However, few towns have been willing to do this, still believing that the State will be forced to improve overly congested facilities.

The JPC believes that given its resources and technical capabilities, the most appropriate role for the MPO is to continue to advocate the need for energy conservation, and to encourage voluntary conservation measures such as carpooling, transit use, etc. In the long run, the connection between land use patterns and energy consumption (among other things) should continue to be made clear to local officials. Towards these ends, the JPC has recently published a discussion paper on the potential for efficient use of fuel in transportation, which outlined various types of approaches, both incentive and disincentive, that could be used either locally or nationally to promote energy efficiency; what is most likely to be the scenario within the area, and what type of policies should be adopted regarding energy in future transportation system assessments and planning.

Nashville, Tennessee

Regional Background

The Nashville urbanized area is the major metropolitan area of central Tennessee, second in size within the State to Memphis. The area is characterized as a large (363 sq. miles), low density area (1,926 people/sq. mile) that exhibits a fairly classic central city/suburban spatial orientation. The area has been growing rapidly in the past decade in terms of economic development, becoming a regional insurance and financial center, increasing activities related to State Government, and in some degree in tourism. Most of this development has remained within the CBD area.

Its residential growth has been somewhat slower than its economic development. Its current population is approximately 470,000, a 5% increase since 1970 (450,000). Original estimates of a 1995 population of 580,000 have recently been scaled back to just under 500,000. Although growth has not been rapid, suburban development away from the central city has been increasing and dominating the area's land use patterns.

MPO Structure

The most unusual governmental feature in the Nashville area is its metro form of government. The City and County are governed under the Nashville-Davidson County Metropolitan Government, and the MPO for the area is the Metropolitan Planning Commission, a division of the Metro Government. This makes the MPO somewhat unique in that a local, rather than a regional agency or a Council of Governments, acts as the lead transportation agency, although the Metro structure makes it somewhat similar to others. The Executive Board of the Planning Commission covers the four local jurisdictions within the county, and is the policy making body for the Nashville urban area MPO.

The responsibility of daily administration of all transportation activities rests with the Executive Staff of the Commission. The Executive Staff primarily constitutes administration leadership of functional agencies, authorities, commissions, departments, divisions and bureaus under legislated jurisdiction of the Executive Board. The Chairman of the Executive Staff is the Executive Director of the Metropolitan Planning Commission. A representative of each modal division of the U.S. Department of Transportation serves as a non-voting member of the Executive Staff.

The Transportation Planning Coordinator is a staff person of the Metropolitan Planning Commission and serves with concurrence by the Metropolitan Planning Organization Executive Board. Supervision of the local transportation planning staff and coordination of transportation planning activities to assure consistency in the process is a responsibility of the Transportation Planning Coordinator. The Coordinator supervises and directs a four person professional transportation planning staff.

Traffic Network Characteristics

The Nashville urbanized area is characterized by a central city-oriented pattern of work related trips and a bypass system of Interstates for through trips. Unlike many urban areas, the Central Business District of Nashville has been increasing its dominance as an employment center in recent years. There has been very limited development of office parks and major activity nodes outside of the downtown area. At the same time, completion of the Interstate system has left Nashville with six Interstates ringing the downtown area, and providing access in all directions around the downtown. The result has been that in spite of new CBD employment, traffic has eased in the CBD area with the elimination of through trips. The extensive Interstate sytem has resulted in new travel patterns which have not become concentrated in any one direction or roadway. This has led to a situation where peak hour traffic problems are minimal, usually lasting no longer than 15 minutes. While residential development patterns have become dispersed across the metropolitan area, most trips still are made in under 20 minutes.

The traffic problems that remain tend to be centered around congested intersections, both within the CBD and on commercial arterials, and poor signal synchronization patterns. There is an analysis currently underway regarding a new roadway facility for the northeast area of the county, but no other major new construction projects are anticipated. Daily VMT is estimated at 8,600,000 and had been growing at a substantial rate during the late 1970's, partially explained by the opening of new Interstate segments. DVMT did decrease slightly in 1979 as a result of the energy situation, although it declined much less than the national average.

Transit

Transit service is provided within the Nashville-Davidson County area by the Metropolitan Transit Authority. Transit serves mainly those dependent upon transit, but has shown to be effective in a number of heavily travelled express corridors. Fares are $1.50 for these express trips and the service is

convenient. Overall ridership had been increasing steadily during the 1970's. Both the 1973 and 1979 gasoline crises resulted in increased ridership levels of over 7%. After the 1979 crisis, the base fare was increased, and it has increased again after that, to a base fare of 60¢. Ridership has declined since the latest fare increase, and media attention on labor settlements also appear to have played a role in ridership levels.

The MTA has recenty purchased a number of articulated buses to add to the capacity of certain high volume routes and to reduce the per passenger costs of operation. Part of the decision to purchase these vehicles was based on the assumption that fuel prices would continue to rise, and that overall ridership would increase as well. Another major improvement to the system is the establishment of a central bus transfer facility in the CBD. There currently is no central faciity, and the proposed new construction will provide a central debarking area for all local and express bus routes. The system currently serves approximately 8.6 million yearly passengers.

Transportation Modelling and Forecasting

The Metro Planning Commission is currently in the process of calibrating its UTPS network. The UTPS effort was originally undertaken by the Tennessee Department of Transportation, but has gradually been given over to the MPO. The staff currently uses the TDOT computer facilities, and has assigned one person to devote approximately half time to its calibration. It is anticipated that once UTPS is in operation, the staff will be able to utilize the air quality impacts output, and is anticipating doing the same for energy impacts. There are some unanswered questions, however, regarding the methodology that is used, the inputs that should be provided, etc. and whether there are better methods to assess energy impacts.

The staff has also utilized a variety of sketch planning models in analyzing various programs. It worked on a modal choice model, and attempted to input significantly higher levels of transit service, ridersharing, etc. to determine the impacts on VMT. Because of the dispersed nature of the development patterns in the area, however, the reduction in VMT would only be at best 2-3% of total travel demand.

Surveillance

The Metro Planning Commission maintains a fairly extensive file of surveillance data, including a program of system performance measures such as average travel time and operating speeds. A program of VMT and ADT changes are maintained on an

annual basis. Mileage by vehicle type is also monitored for input into UTPS as well as vehicle fleet changes.

Energy Conservation Activities

The Metropolitan Planning Commission staff believes that, while energy supplies are plentiful at the present time, another shortage is very likely to occur, and that actions must be taken now to incorporate energy conservation into the transportation planning process. The Nashville area was not impacted heavily during the last two gas shortages, although transit ridership did increase during those two periods. There were no significant gas lines or shortages; some stations did shorten their hours of operation. However, the crisis increased the perception in people's minds of energy concerns and did spark some interest in conservation efforts.

This level of interest on the part of the general public has waned since 1979. The MPC staff believes that they must attempt to keep it in the public domain, as well as assessing the fuel consumption impacts of its various plans, programs and projects.

The MPC generated both a long-term and short-term energy conservation program element in last year's UPWP. The long-term program was intended to assess the energy consumption impacts of its 1995 assigned travel network and to analyze land use pattern changes that could be designed to reduce travel demand, and thus target a percentage reduction in projected transportation related energy use. Although there does not seem to be particular support from the Executive Board to do this, this staff-initiated process is anticipated to be undertaken once UTPS is up and running.

The short range conservation plan was intended to estimate existing fuel consumption, develop methodologies for estimating changes in fuel consumption, develop procedures for assessing the energy impacts of TSM projects, and utilize these results as a criteria for TIP inclusion. This short-term program has been eliminated for the present time due to the lack of a perceived need to do this and the resultant difficulty in justifying the spending of staff time and funding on this element.

However, the MPO is still encouraging the conservation of fuel in its ongoing short range planning activities. In its TSM and air quality work, it has been supporting a number of programs which will have beneficial impacts on energy conservation, even though the specific benefits have not as yet been measured. Foremost among these are traffic flow improvements. Given the

dispersion of population within the area and the reluctance of people to significantly change behavioral habits, increased transit use and ridesharing are unlikely to produce as significant benefits as traffic flow improvments will, although they should nevertheless be pursued. The Nashville TSM and air quality programs are heavily supportive of traffic flow improvements, such as intersection improvements, signal synchronization and reversible lanes. These provide the most immediate benefit; that is, their impacts are seen as soon as they are completed; they do not require behavioral changes and they provide the most benefit for dollar spent. Support for additional park 'n ride lots with express bus connections are also seen as desirable in high density corridors.

Beaumont-Port Arthur, Texas

The Beaumont-Port Arthur, Texas urbanized area is located in the extreme southeast section of Texas on the Louisiana border. The area is heavily industrialized, characterized primarily by its vast petroleum refining industrial areas (12% of the nation's oil refining is done in the area). It is approximately 90 miles from the City of Houston with some interurban traveling occurring. It is the sixth largest metropolitan area in Texas.

There are two central cities within the Jefferson-Orange County Transportation Study area: Beaumont, population 119,000; and Port Arthur, population 61,000. There are also three smaller cities in the 15-25,000 population range: Nederland, Orange and Groves. The urbanized area contains a total of 18 municipalities covering 281 of the area's extremely large 1,669 square mile area. Approximately 50% of the land area within this area is used for industrial purposes, most of which are associated with petroleum refining.

The urbanized area currently has a population of 340,000 persons. Its population has remained relatively stable in the past two decades, as its 1963 population was 314,000. The area's recent growth has occurred in the less densely settled Orange County areas, rather than within Jefferson County, which contains Beaumont and Port Arthur. Projections indicate a year 2000 population of approximately 423,000.

MPO Structure

The Southeast Texas Regional Planning Commission has been designated as the Metropolitan Planning Organization for the Jefferson-Orange County Transportation Study (JORTS). The Policy Board dealing with transportation issues is the Regional Transportation Policy Advisory Committee. This body is composed of 29 members: one member from each of the 18 municipalities; one member each from the three counties; and eight state representatives and senators from the region.

The Southeast Texas Regional Planning Commission staff acts as the coordinator for the MPO and its activities. One full-time staff person at SETRPC is responsible for transportation planning activities. Most of the MPO's transportation funds from FHWA and UMTA are passed through SETRPC to the cities of Beaumont, Port Arthur and Orange for their own use in accomplishing the transportation work tasks outlined in the JORTS Unified Work Program.

Traffic Network

The region's reliance on industrial areas for much of the work trip distribution and staggered shifts of these industrial areas tend to smooth out traffic flows and reduce the propensity for congestion problems within the area. Most of the travel related problems tend to be on the arterials and center around problem intersections and signal synchronization problems. The area is well served by highways and limited access roadways. Travel times tend to be fairly short: home based work trips average about ten minutes, projected to increase to about 11.4 minutes by the year 2000. Other trip times tend to be even shorter. The daily VMT has been estimated to be approximately 5,735,000 in 1978, with a recent annual increase in VMT of about 3%. Projections out to 2000 have included a 1.9% annual VMT growth factor.

In addition to the work trip as a significant percentage of VMT, the area exhibits a high proportion of recreational trips, and many homes include recreational vehicles, pick-ups or other types of truck or recreational vehicle. Home based work trips account for about 18% of the total trip making in the area.

Transit

Each of the cities of Beaumont and Port Arthur operate their own separate transit systems. The City of Beaumont operates a well established system of 25 seven year old vehicles, and the system has been reporting significant ridership increases in recent years, now serving approximately 6,000 riders per day. The City of Port Arthur, which had abandoned its transit system in the sixties, re-established service in 1979, and now has a fleet of 5 small (25 passenger) vehicles. The system has been well received and has carried close to a half million passengers in its first two years of operation. Both systems are preparing to carry out further capital improvements and additional routes, including park and ride services, door to door service and new rolling stock.

Transportation Modelling and Forecasting

Since the staff serving the MPO consists of only one person, all of SETRPC's extensive analytical work is conducted either by the State or by use of private consultants. The traffic network is calibrated by the State Department of Highways and Public transportation. Trip generation work was completed last year and it is anticipated that the network will be up and running fairly soon. The area was not in violation of mobile source air quality standards and thus no air quality modelling or analysis was undertaken. No other modelling techniques or forecasting methodologies are employed.

Surveillance

Some level of surveillance activities are undertaken, by either the State or by the local traffic engineering departments. Information is available regarding transit ridership, travel time in certain corridors and vehicle occupancy in certain areas. The manpower and funds available for additional types of specific data, including those pertaining to energy usage, are too small to maintain an active program.

Energy Conservation Activities

Energy conservation is not perceived as an issue in the region by the general public, or by its local officials. Many of the area's residents are directly or indirectly associated with the petroleum industry and have not experienced any problem with gasoline availability. The 1979 crisis did not affect the area a great deal, and there was a common reaction that it was a conspiracy by the oil companies to drive up prices. While people tend to drive short distances to and from work, they also tend to otherwise drive long distances, particularly on recreational trips, and the price or the availability of gas has not as yet begun to force changes in these driving habits. VMT growth tends to be higher than that found elsewhere over a comparable period of time, particularly given the relatively modest recent growth rate.

Some energy related activities are taking place, however. The MPO employed a consultant to develop an energy contingency plan for the area, in response to 1979 Federal communications emphasizing such energy issues. The plan analyzed the actions that would be necessary given a number of different scenarios of energy shortfalls, and listed a host of emergency measures for such possibilities, including relaxing bus regulations, shorter work weeks, expanded ridesharing programs, etc. However, as more of an ongoing conservation program, it recommended that each community appoint energy coordinators who would meet and work with a regional coordinator out of the SETRPC office, and would investigate citywide fuel management systems, lifecycle purchasing, fleet conversion and management, etc. These are all activities which will save money and energy immediately, but also act as a basis for an emergency situation. The MPO is promoting this activity on those terms. There are also carpool and vanpool promotional programs.

Regarding energy, it is the belief of the Transportation Coordinator that the best strategy for incorporating energy conservation into the transportation planning process is to advance projects that improve traffic flow. Such projects as

signal synchronization and intersection improvements are prime examples of these types of projects. People will support them because they do not impose mandatory private car restrictions nor do they depend on changes in people's travel behavior, yet they result in less idling, higher speeds and improved energy efficiency. The City of Beaumont has received a special TSM grant to extend their downtown signal synchronization program, and a monitoring program to gauge its impacts is being developed. It is hoped that some measure relating to energy conservation can be included or at least extrapolated from the findings. Additional projects in various phases of development in the region deal with traffic flow improvements, realignments, intersections improvements, etc. which will be publicly supported for other than energy reasons, but will at the same time have beneficial results relating to energy.

There is also a perceived need to continue to promote the benefits of ridesharing, as this is a low cost mechanism and each ridesharing participant will provide immediate energy conservation benefits. The State has been very active in this area, and has committed itself to 12 park and ride lots in the area, even though the projected usage is fairly low at this point. It is believed important to have them in place and show people that they are available, as over time more and more people might use them, particularly if energy availability becomes a problem or cost gets to a point where it will make more of a difference than it does now.

It is believed that given the size and characteristics of the Southeast Texas area, the above strategy is the most cost-effective in conserving energy. Energy conservation by itself is not important enough to generate support for a transportation improvement project or program, and individual programs are fairly limited unless changes are made in land use patterns to be more conducive to non-automobile alternative modes. It is believed, however, that there needs to be a body that continued to promote energy conservation and provide a public education program for people to understand the importance of the issue, and further that the MPO is probably the most appropriate body to undertake such a role. In this way, the SETRPC will continue to pursue the recommendations of the contingency plan, particularly those relating to permanent energy coordinators, as a means of keeping the issue before the public; and will continue to promote ridesharing, particularly among the major industrial employers, who with one exception have been slow in providing company ridesharing programs.

The focus in this region will continue to be shorter term transportation projects, mostly TSM activities related to traffic congestion relief. These are most likely to produce energy

consumption savings. It is believed that long-term energy scenarios are too speculative and unknown to be able to develop and politically support longer term mechanisms based on such a future. Although this region cannot justify spending existing funds on specific energy related activities other than ridesharing programs, it does see a need for the Federal transportation agencies to develop for them specific methodologies of deriving energy impacts of transportation systems improvements; especially ones that do not need to rely on extensively developed data bases. It also believes that public education programs and advocacy are the most useful roles that a MPO can play regarding energy. Only over time after constant exposure to the problem will people begin to look critically at their personal driving habits; until that time, it is important to insure that their existing driving habits result in the most energy efficient system.

APPENDIX B

Albuquerque

POTENTIAL ENERGY CONSERVATION MEASURES

MEASURE	LONG-TERM ACTIONS	EMERGENCY ACTIONS	RESPONSIBLE AGENCIES
MEASURES TO RESTRICT TRAFFIC			
- Traffic Limited Zones	* Transit and auto-free malls.	* Limiting travel hours. * Limiting travel routes.	Local government.
- Parking Management	* Reduce free parking or parking supply in congested areas (except park-and-ride lots).	* Reduce or restrict parking supply (except park-and-ride lots).	Local government.
MEASURES TO IMPROVE PEAK HOUR TRAFFIC FLOW			
- Street Improvements	* Computerized signalization of intersections. * Contra-flow lanes. * Ramp metering on freeways. * Engineering improvements at intersections.	* Contra-flow lanes. * Eliminating unnecessary traffic control devices.	Local government.
- Work Hour Adjustments	* Staggered or variable work hours. * Four-day work week.	* Staggered or variable work hours. * Four-day week.	All government agencies, Major employers.
MEASURES TO RESTRICT ENERGY/FUEL			
- Reduce Gasoline Sales	* Odd-even gas purchase system.	* Gas rationing with coupons. * Ban on Sunday gas sales (reduced hours of operation). * Fuel purchase limitations (half-tank or maximum purchase).	Local government with support by State government.
- Reduce Fuel Consumption	* Reduce speed limits. * Fuel taxes. * Registration surcharge on inefficient vehicles. * Vehicle inspection and maintenance.	* Reduce speed limits. * Fuel taxes * Vehicle use stickers (mandate one car-less day per week per vehicle owner).	State government, Local government.

Source: Middle Rio Grande Council of Governments of New Mexico

POTENTIAL ENERGY CONSERVATION MEASURES

MEASURE	LONG-TERM ACTIONS	EMERGENCY ACTIONS	RESPONSIBLE AGENCIES
MEASURES TO INCREASE RIDESHARING			
- Public Information and Marketing Ridesharing	* Maintain central matching service. * Promote ridesharing through media.	* Emergency information services.	RIDEPOOL, Major employers, All government agencies.
- Carpool/Vanpool Programs	* Maintain central matching service. * Establish employer-based carpool/vanpool programs.	* Emergency matching services, centralized and employer-based.	RIDEPOOL, Major employers, All governmental agencies.
- Carpool/Vanpool Incentives	* Preferential lanes. * Preferential parking. * Tax deductions or rebates. * Purchase and operate fleets of vans. * Develop system of park-and-ride lots.	* Preferential parking. * Employee salary benefits. * Fuel subsidies. * Temporary park-and-ride lots.	Governmental agencies, Major employers, Quasi-governmental agencies.
- Taxi Service Improvements	* Taxi fleet expansion. * Build up reserve fleet.	* Shared-ride taxi service (including contract feeder service or night service for the transit system).	Taxi companies.
MEASURES TO IMPROVE TRANSIT SERVICE			
- Public Information and Marketing Transit	* Maintain information "hotline". * Promote transit through media.	* Emergency information services.	Transit operator.
- Route and/or Schedule Modification	* Develop express bus services with park-and-ride lots. * Demand-responsive service (dial-a-ride, subscription, etc.). * Reroute or reschedule low demand runs. * Reduce deadheading (i.e., decentralizing bus storage).	* Alter routes to serve temporary park-and-ride lots. * Demand-responsive service (dial-a-ride, subscription, etc.) * Eliminate low demand runs. * Doubleheading on high demand runs. * Reduce number of stops (i.e., skip-stop scheduling).	Transit operator.

Albuquerque

POTENTIAL ENERGY CONSERVATION MEASURES

MEASURE	LONG-TERM ACTIONS	EMERGENCY ACTIONS	RESPONSIBLE AGENCIES
- Increase Passenger Carrying Capabilities	* Continue fleet expansion * Build up reserve stand-by fleet.	* Activate reserve vehicles. * Provide additional operating, maintenance, supervisory personnel. * Remove seats to increase room for standees. * Utilization of school buses to supplement fleet.	Transit operator, School bus operator.
- Increase Transit Patronage	* Subsidize bus passes. * Differential fares for peak/off-peak periods.	* Differential fares for peak/off-peak periods (i.e., peak period surcharge).	Transit operator.
- Improve Fuel Utilization	* Secure fuel supplies (increase inventories). * Transit vehicle hardware modification.	* Emergency fuel allocation	Transit operator.
- Preferential Treatment for Transit	* Signal preemption. * Reserved lanes on streets and highways.	* Temporary reserved lanes for transit and paratransit.	Local government.
MEASURES TO PROVIDE ALTERNATIVES TO MOTOR VEHICLES			
- Bikeway and Pedways	* Expand bikeway system. * Increase pedestrian areas (malls, walkways, etc.). * Bicycle storage facilities.	* Bicycle storage facilities.	Local government, Major employers.
- Land Use Management	* Mixed-use zoning policies (eliminate need to travel). * Allow higher density of development.	* Curtail operations of public facilities (schools, other public institutions and services). * Close all drive-in facilities.	Local government.

GAS CONSUMPTION CALCULATION FOR
BERNALILLO COUNTY, 1980-1991

Base Data

1977 Population Bernalillo Co.[1]		377,900
1977 Autos and Pickups for Bernalillo Co.[2]		279,926
1979 Gas Consumption, Bernalillo Co.[3]		225,047,576
1979 VMT, Bernalillo Co.[4]		2,511,126,270

Calculation

1979 Autos and Pickups for Bernalillo Co.[5]		301,444
Assume 1/15 of fleet replaced annually[6]	(÷)	15
New 1980 vehicles		20,096
VMT/vehicle/yr., 1980, in Bernalillo Co.[7]	(X)	8,349
VMT for new 1980 Vehicles		167,773,187
1980 mpg for new 1980 vehicles[8]	(÷)	20
Gals. gas consumed by new 1980 vehicles		8,388,659
1980 autos and pickups for Bernalillo Co.		312,816
New 1980 vehicles	(-)	20,096
Pre-1980 vehicles		292,720
VMT/vehicle/yr., 1980, in Bernalillo Co.	(X)	8,349
1980 VMT for pre-1980 vehicles		2,443,919,280
Average mpg for pre-1980 vehicles[9]		11.2
Gals. gas consumed by pre-1980 vehicles		218,207,079
Gals. gas consumed by new 1980 vehicles	(+)	8,388,659
1980 gas consumption for Bernalillo Co.		226,595,738
1980 autos and pickups for Bernalillo Co.,		312,816
Assume 1/15 of fleet replaced annually	(÷)	15
New 1981 vehicles		20,854
VMT/vehicle/yr. 1981	(X)	8,367
VMT for new 1981 vehicles		174,483,088
1981 mpg for new 1981 vehicles	(÷)	22
Gals. consumed by new 1981 vehicles		7,931,049
1981 autos and pickups for Bernalillo Co.		324,617
New 1981 vehicles	(-)	20,854
Pre-1981 vehicles		303,763
VMT/vehicle/yr, 1981, in Bernalillo Co.	(X)	8,367
1981 VMT for pre-1981 vehicles		2,541,585,021
Average mpg for pre-1981 vehicles	(÷)	11.5
Gals. gas consumed by pre-1981 vehicles		221,007,393
Gals. gas consumed by new 1981 vehicles	(+)	7,931,049
1981 gas consumption for Bernalillo Co.		228,938,442

1. Estimates of the Population of the New Mexico, November, 1978, U.S. Dept. of Commerce, Bureau of Census, P-26, No. 77-31. Figure is rounded to the nearest tenth.

2. State of N.M., Transportation Department in "New Mexico Progress, 1977 Economic Report": First New Mexico Bankshare Corporation, Vol. 45., P. 25.

3. New Mexico State Department of Taxation and Revenue.

4. 1979 Vehicle-Miles/Kilometers and Hours of Travel and Air Pollutant Emissions in the Greater Albuquerque Area, MRGCOG, June 1980.

5. 1977 persons/vehicle ration of 1.35 assumed to remain constant through 1991. The number of autos and pickups for each year is calculated by dividing the estimated population for each year by this ratio.

6. Nationwide replacement rate is approximately 10%. The lower replacement rate is chosen because of the dry Albuquerque climate that prevents rust. Assume new vehicles same number as junked vehicles.

7. Assume VMT growth of 4%/yr. 1979 to 1991. Annual VMT value includes only miles traveled in Bernalillo County. Annual VMT divided by total vehicles equals VMT/vehicle/year in Bernalillo County.

8. 1980-85 fuel economy figures from U.S. Dept. of Transportation Fact Sheet, "Subject: Fuel Economy Standards for Model Years 1981-1984 Passenger Cars." 1985 figure used beyond 1985 because no later standards have been set.

9. 1979 VMT divided by 1979 gas consumption.

Source: Middle Rio Grande Council of Governments of New Mexico

Figure 41B

Gas Consumption Calculation for Bernalillo County

1981 autos and pickups for Bernalillo Co.		324,617
Assume 1/15 of fleet replaced annually	(÷)	15
New 1982 vehicles		21,641
VMT/vehicle/yr. 1982, in Bernalillo Co.	(X)	8,385
VMT for new 1982 vehicles		181,464,879
1982 Mpg for new 1982 vehicles	(÷)	24
Gals. gas consumed by new 1982 vehicles		7.561,037
1982 autos and pickups for Bernalillo Co.		336,863
New 1982 vehicles	(-)	21,641
Pre-1982 vehicles		315,222
VMT/vehicle/yr., 1982, in Bernalillo Co.	(X)	8,385
1982 VMT for pre-1982 vehicles		2,643,136,470
Average mpg for pre-1982 vehicles	(÷)	11.9
Gals. gas consumed by pre-1982 vehicles		222,112,308
Gals. gas consumed by new 1982 vehicles	(+)	7,561,037
1982 gas consumption for Bernalillo Co.		229,673,345
1982 autos and pickups for Bernalillo Co.		336,863
Assume 1/15 of fleet replaced annually	(-)	15
New 1983 vehicles		22,458
VMT/vehicle/yr., 1983	(X)	8,404
VMT for new 1983 vehicles		188,729,084
mpg for new 1983 vehicles	(÷)	26
Gals. gas consumed by new 1983 vehicles		7,258,811
1983 autos and pickups for Bernalillo Co.		349,570
New 1983 vehicles	(-)	22,458
Pre-1983 vehicles		327,112
VMT/vehicle/yr., 1983, in Bernalillo Co.	(X)	8,404
1983 VMT for pre-1983 vehicles		2,748,933,479
Average mpg for pre-1983 vehicles	(÷)	12.3
Gals. gas consumed by pre-1983 vehicles		223,490,527
Gals. gas consumed by new 1983 vehicles	(+)	7,258,811
1983 gas consumption for Bernalillo Co.		230,749,338
1983 autos and pickups for Bernalillo Co.		349,570
Assume 1/15 of fleet replaced annually	(÷)	15
New 1984 vehicles		23,305
VMT/vehicle/yr., 1984, in Bernalillo Co.	(X)	8,422
VMT for new 1984 vehicles		196,276,071
mpg for new 1984 vehicles	(÷)	27
Gals. gas consumed by new 1984 vehicles		7,269,484
1984 autos and pickups for Bernalillo Co.		362,758
New 1984 vehicles	(-)	23,305
Pre-1984 vehicles		339,453
VMT/vehicle/yr., 1984, in Bernalillo Co.	(X)	8,422
1984 VMT for pre-1984, vehicles.		2,858,873,166
Average mpg for pre-1984 vehicles	(÷)	12.7
Gals. gas consumed by pre-1984 vehicles		225,108,123
Gals. gas consumed by new 1984 vehicles	(+)	7,269,484
1984 gas consumption for Bernalillo Co.		232,377,607

SUMMARY OF POLICIES (energy)

Policy #1: APPROPRIATE PROJECTS TO SPEED AND SMOOTH THE FLOW OF TRAFFIC SHALL BE IMPLEMENTED AND SHALL BE FUNDED BY REVENUE RECEIVED FROM A ONE CENT TAX PER GALLON ON GASOLINE AND DIESEL FUEL, IMPOSED ON THE FUEL SOLD IN THE AREA ENCOMPASSED BY SCHOOL DISTRICTS 4J, 19 AND 52. TO FACILITATE THE ADOPTION OF THE TAX (TO BE ASSESSED AND COLLECTED AT THE WHOLESALE LEVEL), THE CITIES AND THE COUNTY SHALL WORK TO HAVE THE APPROPRIATE LEGISLATION PLACED ON THE BALLOT FOR VOTER RATIFICATION AT THE NEXT GENERAL ELECTION.

Policy #2: A MANDATORY VEHICLE INSPECTION AND MAINTENANCE PROGRAM (TO INCLUDE A DIAGNOSIS OF ENGINE EFFICIENCY) SHALL BE IMPLEMENTED IN THE EUGENE-SPRINGFIELD AIR QUALITY MAINTENANCE AREA. TO FACILITATE ESTABLISHMENT OF SUCH A PROGRAM, THE CITIES AND COUNTY SHALL WORK WITH THE DEPARTMENT OF ENVIRONMENTAL QUALITY AND THE 1981 SESSION OF THE STATE LEGISLATURE TO INTRODUCE, AND TO HELP ENSURE PASSAGE OF THE PROPER ENABLING LEGISLATION.

Policy #3: TO ENCOURAGE EFFICIENT TRAFFIC MOVEMENT DURING EVENING/NIGHTTIME HOURS, OPERATION OF TRAFFIC SIGNALS ON A FLASHING AMBER/RED PHASE IN THAT TIME PERIOD SHALL BE IMPLEMENTED IF FEASIBLE.

Policy #4: THE PUBLIC VEHICLE FLEET REPLACEMENT SHALL EXCEED THE APPLICABLE FEDERAL FLEET AVERAGE FUEL ECONOMY OBJECTIVES; PUBLIC VEHICLES SHALL NOT TRAVEL AT A SPEED IN EXCESS OF 50 MPH.

Policy #5: METROPOLITAN PARKING FACILITIES AND RATE STRUCTURE SHALL GIVE PREFERENCE TO COMPACT AUTOMOBILES.

Policy #6: THE FEASIBILITY OF USING RECYCLED ASPHALT OR USING SULFUR AS AN ADDITIVE WHEN APPLYING ASPHALTIC CONCRETE PAVEMENT SHALL BE INVESTIGATED.

Policy #7: SUPPORT SHALL BE GIVEN, THROUGH CONGRESSIONAL AND LEGISLATIVE REPRESENTATIVES, TO ACTIONS WHICH ALLOW MOTOR FUELS TO REFLECT WORLD MARKET VALUES.

Policy #8: ANNUAL TRANSPORTATION ENERGY REVIEWS OF GOVERNMENTAL SERVICES AND REGULATIONS SHALL BE PERFORMED. CITY AND COUNTY CODE PROVISIONS AND GOVERNMENTAL PROCEDURES REQUIRING UNNECESSARY TRAVEL SHALL BE MODIFIED TO ALLOW FOR THE LEAST TRAVEL POSSIBLE WHILE STILL PROVIDING FOR THE HEALTH, SAFETY AND WELFARE OF THE PUBLIC.

Policy #9: THE ACQUISITION, DEVELOPMENT AND PROMOTION OF PARK AND RECREATION AREAS IN CLOSE PROXIMITY TO THE METROPOLITAN AREA SHALL BE PURSUED.

Policy #10:* LAND USE POLICIES USING DENSITY AND SPATIAL CONFIGURATIONS TO REDUCE THE NEED TO TRAVEL, TO ENCOURAGE SHORTER TRIP LENGTHS, TO INCREASE ACCESS TO TRANSIT AND TO MAKE ALTERNATIVE MODES OF TRAVEL MORE ATTRACTIVE SHALL BE IMPLEMENTED. TOWARD THAT END, THE FOLLOWING ACTIONS HAVE BEEN IDENTIFIED AS EFFECTIVE MEANS TO PROMOTE TRANSPORTATION ENERGY CONSERVATION AND TO INCREASE ACCESS TO TRANSIT.

Source: LCOG, Energy Conservation Plan, 1980

- Development (or redevelopment) of medium and high density residential, commercial and retail land use in the vicinity of transit transfer stations, and of medium density residential use along major transit corridors identified in the 2000 Transportation Plan.

- Development (or redevelopment) of medium and high density residential land use in proximity (within one mile) to downtown Eugene and Springfield.

Policy #11:* DENSITIES, LOCATIONS AND MIXES OF LAND USES TENDING TO DECREASE THE LENGTH OF REQUIRED DAILY TRIPS AND TO ENCOURAGE CONSOLIDATION OF RELATED TRIPS SHOULD BE PROMOTED.

Policy #12:* OVERALL INCREASES IN METROPOLITAN DENSITY SHALL BE PROMOTED.

Policy #13: INCENTIVES FOR INCREASED CARPOOLING AND RIDERSHARING, AS IDENTIFIED IN THE 2000 TRANSPORTATION PLAN, OR THE EUGENE PARKING MANAGEMENT REPORT, SHALL BE IMPLEMENTED.

Policy #14: WHERE FEASIBLE, UNDERUTILIZED PARKING AREAS SHALL BE CONVERTED TO INFORMAL PARK AND RIDE LOTS.

Policy #15: PARTICIPATION IN A GOVERNMENTAL RIDE-SHARING CLEARINGHOUSE FOR OUT-OF-COUNTY BUSINESS TRAVEL BY GOVERNMENT EMPLOYEES SHALL BE REQUIRED.

Policy #16: FEDERAL-AID URBAN SYSTEM FUNDS SHALL ANNUALLY BE ALLOCATED TO CONTINUE OPERATION OF AN AREAWIDE CARPOOLING PROGRAM AND TO CONTINUE OPERATION OF L-COG'S COMPUTER MATCHING PROGRAM.

Policy #17: PRICING AND FINES SHALL BE USED TO DISCOURAGE SINGLE-OCCUPANCY AUTOMOBILE TRAVEL TO EUGENE DOWNTOWN BY INCREASING PARKING RATES AND INCREASING THE FINE AND BAIL SCHEDULE FOR VIOLATIONS OF THE FREE PARKING PROGRAM.

Policy #18: A SHARED-RIDE RATE STRUCTURE FOR METROPOLITAN TAXICAB OPERATION SHALL BE ESTABLISHED.

Policy #19: LOCAL STAFF ASSISTANCE SHALL BE PROVIDED TO NEIGHBORHOOD OR CHURCH GROUPS TO HELP PARTICIPATE IN A RIDE-SHARING PROGRAM.

Policy #20: PROVISIONS THAT PERMIT BUSINESS, INDUSTRY AND INSTITUTIONS TO REDUCE PARKING SPACE REQUIREMENTS (PROVIDED THAT LONG TERM TRANSIT OR RIDE-SHARING COMMITMENTS ARE OBTAINED) SHALL BE INVESTIGATED AND, IF FEASIBLE, IMPLEMENTED.

Policy #21: BICYCLE AND PEDESTRIAN COMMUTER TRAVEL SHALL BE PROMOTED BY PROVIDING SAFE, EFFICIENT AND WELL-MAINTAINED BICYCLE ROUTES, PROVIDING SECURE BICYCLE STORAGE FACILITIES, AND THROUGH EDUCATION AND MARKETING PROGRAMS.

Policy #22: ORDINANCES SHALL BE DEVELOPED REQUIRING COVERED, SECURE BICYCLE PARKING AT LOCATIONS SUCH AS APARTMENT/CONDOMINIUM COMPLEXES, PUBLIC BUILDINGS, COMMERCIAL AREAS, DOWNTOWN AREAS.

Policy #23: LANE TRANSIT DISTRICT EFFORTS TO INCREASE BUS AVAILABILITY SHALL BE SUPPORTED.

Policy #24: GOVERNMENT EMPLOYERS SHALL ESTABLISH FLEXTIME, OR STAGGERED HOUR WORK SCHEDULES IF COMPATIBLE WITH OTHER NEEDS; PRIVATE EMPLOYERS SHALL BE ENCOURAGED TO DO THE SAME.

Akron Metropolitan Area Transportation Study (AMATS)

- EVALUATION OF TRANSPORTATION ENERGY CONSERVATION ACTIONS

Category/Action	Description	Responsible Agency	Time To Implement	Effects on Tripmaking	Cost	Impacts on Operations	Implementation Feasibility
1. INCENTIVES TO USE HIGH OCCUPANCY VEHICLES							
A. BUS/CARPOOL - Only Lanes on Urban Freeways & Arterials	Temporarily signing and striping lanes on congested urban freeways and arterials for exclusive use by transit and autos with 3 or more occupants. HOV lanes could be most effective if enforced during peak hours.	MUNICIPALITY COUNTY STATE	MEDIUM	E	MEDIUM	N	LOW
B. BUS/CARPOOL - New construction	Constructing new lanes as freeways are reconstructed or with new freeways.	MUNCIPALITY COUNTY STATE	LONG	E	HIGH	+	MEDIUM
C. PERMANENT PARK AND POOL LOTS	Analysis of work trip patterns and selection and acquisition of sites for park and pool lots. Publicity and policing are important components of this strategy.	MUNICIPALITY COUNTY STATE	MEDIUM	E	MEDIUM	+	MEDIUM
D. TEMPORARY PARK AND POOL LOTS	Work trip patterns are studied and parking lots at schools, churches, shopping areas, drive-in movies, etc. are designated as temporary park-and pool-lots.	MUNICIPALITY COUNTY STATE	SHORT	E	LOW	#	LOW
E. PERMANENT PARK-AND-RIDE LOTS	Parking lots are acquired on urban fringe for commuter parking near outer ends of transit routes. Commuters pay to park their cars and use transit rather than driving into the urban area. Lot location and publicity are important.	METRO RTA KSU CBS MUNICIPALITIES COUNTY STATE	MEDIUM	E	MEDIUM	+	MEDIUM
F. TEMPORARY PARK-AND-RIDE LOTS	Work trip patterns are studied and parking lots at schools, churches, shopping areas, drive-in movies, etc. are designated as temporary park-and-ride lots. Involves agreement between lot owners and implementing agency, publicity of lot, parking policy and investigation of legal aspects.	METRO RTA KSU-CBS MUNICIPALITY COUNTY STATE	SHORT	E	LOW	#	LOW
G. RIDESHARING INCENTIVES	Employers offer preferential parking, bonuses, preferential work hours and other incentives to rideshare. Making a company van available for pooling and private use of driver has been used by large employers in other areas.	EMPLOYER	SHORT	E	LOW-MEDIUM	+	LOW

Symbol Legend
O - Can improve average operating speed
V - VMT is reduced by providing a more direct trip
+ - Tends to have positive impacts
N - Tends to have negative impacts
- varies according to situation
R - Reduces auto or bus VMT
E - Encourages transit and ridesharing
U - Reduces transit usage

Source: AMATS, Energy Considerations in Transportation Planning, 1982

Category/Action	Description	Responsible Agency	Time To Implement	Effects on Tripmaking	Cost	Impacts on Operations	Implementation Feasibility
2. IMPROVING TOTAL VEHICULAR TRAFFIC FLOW							
A. IMPROVED SIGNAL SYSTEMS	Study of existing signal systems and their operation with revision to facilitate vehicle flow and minimize delays.	MUNICIPALITY COUNTY STATE	SHORT	0	MEDIUM	+	HIGH
B. ONE-WAY STREETS	Study of existing traffic patterns and designation of one-way pairs with signing and striping.	MUNICIPALITY	SHORT	0	LOW	+	MEDIUM
C. REVERSIBLE LANES	Used in corridor with highly directional traffic movements by time of day. Use of signing/signaling to designate a particular facility as one-way (inbound) during A.M. peak and alternate-way (outbound) during P.M. peak.	MUNICIPALITY	MEDIUM	0	MEDIUM	#	LOW
D. ELIMINATE ON-STREET PARKING	Elimination of on-street parking on arterials to provide additional lanes for traffic and reduce congestion.	MUNICIPALITY	SHORT	0	LOW	+	LOW
E. ELIMINATE UNNECESSARY TRAFFIC CONTROLS	Study of existing traffic flow and elimination of traffic lights which are not arranged.	MUNICIPALITY COUNTY STATE	SHORT	0	LOW	+	LOW
F. TURNING MOVEMENT RESTRICTIONS	Turning movements at selected intersections are eliminated or restricted during peak hours. Has most potential on heavily used arterials where turning movements create delays.	MUNICIPALITY	SHORT	0	LOW-MEDIUM	#	LOW
G. ENFORCEMENT OF EXISTING TRAFFIC REGULATIONS	Better enforcement of speed limits would result in fuel savings. Parking regulation enforcement could eliminate congestion caused by illegally parked vehicles.	MUNICIPALITY STATE	SHORT	0	MEDIUM	+	MEDIUM
3. INCREASING CAR AND VAN OCCUPANCY							
A. EMPLOYER CAR-POOL MATCHING PROGRAMS	Employers encourage and assist workers in forming carpools and vanpools with either manual or computer matching programs. AMATS could provide organizational and technical assistance to employers.	EMPLOYERS	SHORT-MEDIUM	E	LOW	+	MEDIUM

Symbol Legend

0 - Can improve average operating speed
V - VMT is reduced by providing a more direct trip
+ - Tends to have positive impacts
− - Tends to have negative impacts
- varies according to situation
R - Reduces auto or bus VMT
E - Encourages transit and ridesharing
U - Reduces transit usage

Category/Action	Description	Responsible Agency	Time To Implement	Effects on Tripmaking	Cost	Impacts on Operations	Implementation Feasibility
B. AREAWIDE CAR-POOL MATCHING PROGRAMS	Using radio/TV/newspaper, public is encouraged to carpool. AMATS offers matching assistance via telephone or mail. Suggest use of carpool hotline number.	AMATS NEWS MEDIA	SHORT	E	LOW	+	MEDIUM
C. CARPOOL PUBLIC INFORMATION	Publicize information on energy and economic savings of ridesharing. Possible use of ads as free public service announcements.	AMATS METRO RTA PARTA NEWS MEDIA EMPLOYERS	SHORT	E	LOW	+	MEDIUM
D. NEIGHBORHOOD RIDESHARING	Ridesharing implemented at neighborhood level, encouraged by public promotion of carpool benefits. Groups of residents organize to consolidate tripmaking for both work and secondary trips. Has potential for large apartment complexes also.	PRIVATE CITIZENS	SHORT	E	LOW	+	MEDIUM
4. INCREASING TRANSIT CAPACITY AND PATRONAGE							
A. ESTABLISH NEW ROUTES AND EXTEND EXISTING ROUTES	Route restructuring and expansion to serve more people within existing RTA areas.	METRO RTA PARTA KSU-CBS	SHORT	E	MEDIUM	+	HIGH
B. EXTEND SERVICE INTO AREAS OUTSIDE EXISTING RTA	Based upon AMATS community studies and negotiations with local officials, extend transit service into suburban communities where feasible. Action must be based on careful study and be a lasting service, not a temporary, crisis-oriented service.	METRO RTA PARTA KSU-CBS	MEDIUM	E	MEDIUM	+	VARIES
C. CROSSTOWN BUS ROUTES	Provide more direct service to major generators by eliminating downtown transfer points.	METRO RTA PARTA KSU-CBS	SHORT	E	MEDIUM	+	VARIES
D. INCREASED ROUTE SPACING	Restructure routes to increase spacing between routes from 1/2 mile to 1 mile.	METRO RTA PARTA KSU-CBS	SHORT	U	LOW	+	LOW
E. ROUTE SCHEDULE CHANGES	Based upon ridership, increase or decrease route headways for maximum route efficiency. Would reduce service to some areas in order to increase passengers per mile.	METRO RTA KSU-CBS	SHORT	E	LOW	+	VARIES
F. EXPAND DEMAND-RESPONSIVE SERVICE	Improve quantity and quality of S.C.A.T. type service to meet increased demand from elderly and handicapped with decreased auto alternatives. Expand into new areas.	METRO KSU-CBS PARTA	MEDIUM	E	MEDIUM	/	HIGH
G. MODIFY S.C.A.T. SERVICE	Reduce or eliminate S.C.A.T. service. Replace buses with taxis.	METRO RTA	SHORT	E	LOW	+	LOW

Category/Action	Description	Responsible Agency	Time To Implement	Effects on Tripmaking	Cost	Impacts on Operations	Implementation Feasibility
H. EXPAND SATURDAY, SUNDAY, HOLIDAY SERVICE	Provide transit service on Sunday and holidays, extend hours on Saturday.	METRO RTA KSU-CBS	SHORT	E	MEDIUM	#	LOW
I. SUBSCRIPTION BUS SERVICE	Transit operator contracts with employer to provide specialized express service for employers. Service is operated only for shift arrival/departures.	METRO RTA KSU-CBS	SHORT	E	LOW	#	HIGH
J. USE OF SCHOOL AND CHURCH BUSES	Transit operators lease area school and church buses to provide feeder service or supplemental service to regular line service.	METRO RTA KSU-CBS	SHORT	E	MEDIUM	#	LOW
K. USE OF SHARED RIDE TAXI	Transit operators contract with taxi companies to provide shared-ride taxi service. Taxis could replace buses on low use routes and supplement buses on high use routes. Taxis could also provide feeder service to regular line service.	METRO RTA KSU-CBS	SHORT	E	MEDIUM	#	LOW
L. INCREASE TURNBACK OPERATIONS	Some buses on some routes turn around and do not serve the end of the route, usually only during off-peak. Reduces service to marginally-productive areas.	METRO RTA KSU-CBS	SHORT	E	LOW	#	MEDIUM
M. INCREASE DOUBLE-HEADING ON KEY ROUTES	Analyze system ridership and increase buses on heavily-used routes.	METRO RTA KSU CBS	SHORT	E	LOW	+	HIGH
N. USE OF OLD BUSES	Retain old buses which are replaced. Use the old buses for regular line service as appropriate.	METRO RTA KSU-CBS	SHORT	E	LOW	N	LOW
O. REDUCE FLEET SPARE RATIO	By revising maintenance schedules, the number of spare buses can be reduced from 10% to a smaller number, adding buses to peak hour operations.	METRO RTA KSU-CBS	SHORT	E	LOW	N	LOW
P. REVISE MAINTENANCE SCHEDULES	Conduct routine bus maintenance during off-peak and evening hours, to place more vehicles in service during peak. Involves shifting schedules of maintenance workers.	METRO RTA KSU CBS	SHORT	E	LOW	N	LOW
Q. REDUCE DEAD-HEAD MILEAGE	About 10% of all METRO route mileage is non-revenue mileage (deadhead). Strategy is to reduce this mileage by restructuring routes.	METRO RTA KSU CBS	SHORT	R	LOW	+	MEDIUM
R. REDUCE NUMBER OF STOPS	Restructure routes so that buses do not serve every stop. Possibility of some runs which serve every stop and others with limited stops.	METRO RTA KSU CBS	SHORT	U	LOW	+	LOW

Symbol Legend

O - Can improve average operating speed
V - VMT is reduced by providing a more direct trip
+ - Tends to have positive impacts

N - Tends to have negative impacts
- varies according to situation
R - Reduces auto or bus VMT

E - Encourages transit and ridesharing
U - Reduces transit usage

Category/Action	Description	Responsible Agency	Time To Implement	Effects on Tripmaking	Cost	Impacts on Operations	Implementation Feasibility
S. INCREASE STANDEE CAPACITY OF BUSES	Remove some seats to provide additional room for standees. Requires careful public explanation.	METRO RTA KSU CBS	SHORT	U	LOW	N	LOW
T. USE MORE EFFICIENT VEHICLES FOR EVENING AND OFF-PEAK SERVICE	To save fuel, use smaller buses, vans and taxis for evening and off-peak service where capacity isn't needed.	METRO RTA KSU CBS	MEDIUM	IMPROVES VEHICLE EFFICIENCY	MEDIUM-HIGH	+	MEDIUM
U. RESTRUCTURE FARES	Raise peak hour fares or reduce off-peak fares to encourage choice peak riders to ride during off-peak.	METRO RTA KSU CBS	SHORT	R	LOW	+	LOW
V. INCREASED MARKETING EFFORTS	Continue and expand efforts to promote economic and energy savings of transit. Couple general advertising with promotion at specific employee locations.	METRO RTA KSU CBS	SHORT	E	LOW	+	HIGH
W. PUBLIC INFORMATION SYSTEM	Establish centralized source to provide information on bus routes and schedules, taxi fares, carpool information and other needed information. "HOTLINE" for transportation information.	METRO RTA KSU-CBS AMATS NEWS MEDIA	SHORT	E	LOW	+	HIGH
5. ENCOURAGE WALK AND BICYCLE MODES							
A. DEVELOP BIKE-WAY SYSTEM	Develop a system of bicycle paths, lanes and routes throughout area communities and the region. Involves planning, construction, maintenance and policing. Also includes development of suitable bicycle storage facilities and safety education program.	MUNICIPALITES COUNTY STATE AKRON METRO PARK DISTRICT	LONG	R	HIGH	+	MEDIUM
B. BICYCLE-TRANSIT INTERFACE	Provide racks or trailers to enable buses to carry bicycles, enabling riders to travel from areas without transit service and use the bus. Bike racks at park and ride lots.	METRO RTA KSU CBS	MEDIUM	R,E	MEDIUM	+	MEDIUM
6. IMPROVING EFFICIENCY OF TAXI SERVICE							
A. INCREASED TAXI-RTA COORDINATION	Transit operators contract with taxi companies to provide suburban feeder service, supplement regular line service, replace SCAT buses, etc.	METRO RTA KSU CBS TAXI COMPANIES	SHORT	E	LOW	+	MEDIM
B. CONTRACT WITH TAXIS, OTHER PARATRANSIT	Transit operator contracts with jitney operators, social service agencies with vehicles for specialized transit service	METRO RTA KSU CBS SOCIAL SER. AGENCIES JITNEY OPERATORS	SHORT	E	LOW-MEDIUM	+	MEDIUM

Symbol Legend

0 - Can improve average operating speed
V - VMT is reduced by providing a more direct trip
+ - Tends to have positive impacts
N - Tends to have negative impacts
- varies according to situation
R - Reduces auto or bus VMT
E - Encourages transit and ridesharing
U - Reduces transit usage

Category/Action	Description	Responsible Agency	Time To Implement	Effects on Tripmaking	Cost	Impacts on Operations	Implementation Feasibility
7. RESTRICTING TRAFFIC							
A. AUTO RESTRICTED ZONES AND HOUR RESTRICTIONS	Auto traffic is restricted in certain areas, usually central business districts. This may be a total prohibition of traffic or autos may be prohibited within the zone during certain hours (ie. peak) of the day.	MUNICIPALITIES	MEDIUM	E	HIGH	N	LOW
8. REDUCING THE NEED TO TRAVEL							
A. FOUR-DAY WORK WEEK OR STAGGERED WORK HOURS	Employers change schedule to four 10-hour work days, eliminating one work day per week. Schedules can be developed which enable the company to continue five or six day operations by staggering individual employee schedules. This action is already used in some companies	EMPLOYERS	SHORT	R	LOW	+	VARIES
B. EXPANSION OF HOME DELIVERY OF GOODS	Businesses expand home delivery of goods and services, reducing the need for shopping and other trips. Replaces many individual shopping trips with one multi-stop trip by business.	AREA BUSINESSES	SHORT	R	LOW	+	LOW
C. SUBSTITUTE COMMUNICATION FOR TRAVEL	Greater use of telephone, other communications techniques, to replace actual face to face contacts. For instance, use of telephone conference call instead of holding a meeting, or telephone ordering of groceries, etc.	PRIVATE CITIZENS BUSINESSES	SHORT	R	LOW	+	LOW
9. TRANSPORTATION PRICING MEASURES							
A. INCREASING PARKING COSTS	Municipality levies surcharge on parking spaces in downtown areas to discourage automobile travel to these areas. Surcharge could apply only to all-day parking and could be reduced or eliminated for higher occupancy autos. Transit service must be an alternative available to most drivers.	MUNICIPALITES	SHORT	E	LOW	+	LOW
B. INCREASING FUEL TAXES	State levies sales tax on gasoline to significantly raise cost per gallon. Added cost is incentive to conserve.	STATE	SHORT	E	LOW	+	LOW
10. ENERGY RESTRICTION MEASURES							
A. GASOLINE RATIONING	President or Governor institutes odd-even coupon or some other type of gasoline rationing program. Transit fuel available.	PRESIDENT GOVERNOR	SHORT	R,E	LOW	+	LOW
B. BAN ON SUNDAY SATURDAY GAS SALES	National, state or local ban on gasoline sales on Saturday and/or Sunday	PRESIDENT GOVERNOR COUNTY MUNICIPALITIES	SHORT	R,E	LOW	+	LOW

TEEM: Energy Savings

E_o and E_1 are calculated using various techniques appropriate to the specific measure, but they use a number of common variables, as follow:

ATL_{oi}	=	Average trip length (one-way), mode i, before measure (in miles)
ATL_{1i}	=	Average trip length (one-way), mode i, after measure (in miles)
ND_{oi}	=	Total number of delays, mode i, before measure
ND_{1i}	=	Total number of delays, mode i, after measure
FD_{oi}	=	Delay-dependent fuel consumption rate, mode i, before measure (in gal/delay per vehicle)
FD_{1i}	=	Delay-dependent fuel consumption rate, mode i, after measure (in gal/delay per vehicle)
FS_{oi}	=	Speed-dependent fuel consumption rate, mode i, before measure (in gal/mile per vehicle) (See Appendix B.)
FS_{1i}	=	Speed-dependent fuel consumption rate, mode i, after measure (in gal/mile per vehicle) (See Appendix B.)
N	=	Number of lanes (directional)
NBA	=	Number of buses added to the system
Q_{oi}	=	Traffic volume, mode i, before measure (in vehicle/hour or/day)
Q_{1i}	=	Traffic volume, mode i, after measure (in vehicle/hour or/day)
SL_o	=	Section length before measure (in miles)
SL_1	=	Section length after measure (in miles)
V_o	=	Average vehicle running speed before measure (in mph)
V_1	=	Average vehicle running speed after measure (in mph)
Vd	=	Facility design speed (in mph)
VMT_{oi}	=	Vehicle miles of travel, mode i, before measure
VMT_{1i}	=	Vehicle miles of travel, mode i, after measure
X_{oi}	=	Vehicle occupancy factor before measure (in persons/vehicle) (See Appendix B.)
X_{1i}	=	Vehicle occupancy factor after measure (in persons/vehicle) (See Appendix B.)

Mode (i) subscripts are as follow:

1	=	Automobiles
2	=	Carpools or Vanpools
3	=	Buses
4	=	Paratransit
5	=	Combination
6	=	Trucks

For a general case, then, energy savings would be the difference in energy consumed before and after implementation of the measure:

i.e., $ES = E_o - E_1$

where E_o (or E_1) is the sum of:

(1) fuel consumed running for each mode i

$Q \cdot SL \cdot FS$ (veh/day · mi · gal/mi/veh = gal/day) (ATL may replace SL)

plus

(2) fuel consumed for delay for each mode i

$Q \cdot ND \cdot FD$ (veh/day · delays · gal/delay/veh = gal/day)

The complete calculation would be:

$$ES = \Sigma_i (Q_{oi} \cdot SL_o \cdot FS_{oi} + Q_{oi} \cdot ND_{oi} \cdot FD_{oi}) - \Sigma_i (Q_{1i} \cdot SL_1 \cdot FS_{1i} + Q_{1i} \cdot ND_{1i} \cdot FD_{1i})$$

or

$$ES = \Sigma_i E_{oi} - \Sigma_i E_{1i}$$

Source: Office of the Governor, State of Florida, Transportation Energy Efficiency Manual. 1981

For Free-Flowing Traffic Conditions:

$FD_f = (FI \cdot DT_{idling} + FDA)$

where

FI = Fuel consumption rate while idling (in gal/sec per vehicle) (See Appendix B).

DT_{idling} = Average time per delay while idling (in seconds). (DT_{idling} can be approximated by recording delay readings over a street section to be evaluated. Average DT_{idling} on an approach to a signalized intersection can be estimated by dividing the red signal time per phase (R) by two, i.e., DT_{idling} (at signal) $= \frac{R}{2}$. DT_{idling} at a stop sign, for example, must be measured or estimated.)

FDA = Fuel consumed while decelerating and accelerating (in gal/delay per vehicle) (See Appendix B).

Also, $ND_f = NSI \cdot R/C + MBD + SSD + BSD + Other$

where

ND_f = Total number of delays, free flowing

NSI = Number of signalized intersections

R = Red signal time per phase

C = Total signal cycle length

R/C = Probability of a delay

MBD = Number of mid-block delays

SSD = Number of stop sign delays

BSD = Number of bus stop delays

Other = Number of other stops (delays)

For Congested Traffic Conditions:

$FD_c = FI \cdot (N \cdot C + DT_{idling}) + FDA$

where

FI = As above, under Free Flowing

N = Number of complete signal cycles delayed

C = Total signal cycle length (in seconds)

DT_{idling} = As above, under Free Flowing

FDA = As above, under Free Flowing

Also, $ND_c = NSI \cdot R/C + N \cdot R/C + MBD + SSD + BSD + Other$

where

ND_c = Total number of delays, congested.

NSI and other terms = as above, under Free Flowing.

Source: Office of the Governor, State of Florida, Transportation Energy Efficiency Manual. 1981

ECONS: Sample Calculations

I. Compute Existing Fuel Consumption

A. Determine Average Speeds:

$\bar{V} = \dfrac{\text{Distance (Miles)} \times 60 \text{ Minutes/HR}}{\text{Travel Time (Minutes)}}$

AM Peak:

$\bar{V} = \dfrac{2.3 \times 60}{11} = 12.55$ mph

PM Peak:

$\bar{V} = \dfrac{2.3 \times 60}{13.6} = 10.15$ mph

Off Peak:

$\bar{V} = \dfrac{2.2 \times 60}{8.6} = 15.35$ mph

B. Compute Volumes:

Weekdays

AM Peak: Total Volume = 2538

Passenger Cars = 2538 X .95 = 2411
Trucks = 2538 X .05 = 127

PM Peak: Total Volume = 3736

Passenger Cars = 3736 X .95 = 3549
Trucks = 3736 X .05 = 187

Off Peak: Total Volume = ADT - AM - PM = 8431

Passenger Cars = 8431 X .90 = 7588
Trucks - 8431 X .10 = 843

Week Ends:

Passenger Cars = 10630 X .90 = 9567
Trucks = 10630 X .10 = 1063

C. Determine Fuel Consumption Factors: K

AM Peak: $\bar{V}$ = 12.55 mph

Passenger Cars - (Table 1) = 0.0958 gal/veh-mi
Trucks (Figure 5) = 0.364 gal/veh-mi

PM Peak: $\bar{V}$ = 10.15 mph

Passenger Cars - (Table 1) = 0.1098 gal/veh-mi
Trucks (Figure 5) = 0.409 gal/veh-mi

Off Peak: $\bar{V}$ = 15.35 mph

Passenger Cars - (Table 1) = 0.0948 gal/veh-mi
Trucks (Figure 5) = 0.328 gal/veh-mi

D. Compute Weekday Fuel Consumption

Basic Formula:

Fuel Consumption (gal/yr) = K (gal/veh-mi) X D (miles) X Volume (veh/hr) X # days/year

AM Peak:

Passenger Cars - 0.0958 X 2.3 X 2411 X 260 = 138,122 gal/yr
Trucks - 0.364 X 2.3 X 127 X 260 = 27,644 gal/yr

PM Peak:

Passenger Cars - 0.1098 X 2.3 X 3549 X 260 = 233,029 gal/yr
Trucks - 0.409 X 2.3 X 187 X 260 = 45,737 gal/yr

Off Peak:

Passenger Cars - 0.0948 X 2.2 X 7588 X 260 = 367,624 gal/yr
Trucks - 0.328 X 2.2 X 843 X 260 = 157,973 gal/yr

E. Compute Weekend Fuel Consumption

Same Basic Formula as Weekday

Passenger Cars - 0.0948 X 2.2 X 9567 X 105 = 187,046 gal/yr
Trucks - 0/328 X 2.2 X 1063 X 105 = 80,541 gal/yr

Total Weekend Fuel Consumption = 267,587 gal/yr

Total Fuel Consumption = 1,237,716 gal/yr

II. Compute Estimated Fuel Consumption After Improvement

A. Use Table 2 to determine appropriate reduction factor: Factor = 20%

B. Determine estimated average speeds for improvement

AM Peak $\bar{V}$ = 12.55 X 1.20 = 15.06 mph
PM Peak $\bar{V}$ = 10.15 X 1.20 = 12.18 mph
Off Peak $\bar{V}$ = 15.35 X 1.20 = 18.42 mph

C. Compute New Fuel Consumption Factors

AM Peak $\bar{V}$ = 15.06 mph

Passenger Cars - (Table 1) = 0.0856 gal/veh-mi
Trucks (Figure 5) = 0.334 gal/veh-mi

PM Peak $\bar{V}$ = 12.18 mph

Passenger Cars - (Table 1) = 0.0975 gal/veh-mi
Trucks (Figure 5) = 0.370 gal/veh-mi

Off Peak $\bar{V}$ = 18.42 mph

Passenger Cars - (Table 1) = 0.0767 gal/veh-mi
Trucks (Figure 5) = 0.299 gal/veh-mi

D. Compute Estimated Weekday Fuel Consumption

AM Peak

Passenger Cars - .0856 X 2.3 X 2411 X 260 = 123,416 gal/yr
Trucks - .334 X 2.3 X 127 X 260 = 25,366 gal/yr

PM Peak

Passenger Cars - .0975 X 2.3 X 3549 X 260 = 206,924 gal/yr
Trucks - .370 X 2.3 X 187 X 260 = 41,376 gal/yr

Off Peak

Passenger Cars - .0767 X 2.2 X 7588 X 260 = 332,509 gal/yr
Trucks - .299 X 2.2 X 843 X 260 = 144,006 gal/yr

E. Compute Estimated Weekend/Holiday Fuel Consumption

Passenger Cars - .0767 X 2.2 X 9567 X 105 = 169,505 gal/yr
Trucks - .299 X 2.2 X 1063 X 105 = 73,420 gal/yr

Total Estimated Fuel Consumption = 1,116,522 gal/yr

Fuel Consumption Savings

Fuel Consumption Before	1,237,716 gal/yr
Fuel Consumption After	1,116,522 gal/yr
Fuel Savings	121,194 gal/yr

% Reduction in Fuel Consumption = 121,194/1,237,716 = 9.8%

☆U.S. GOVERNMENT PRINTING OFFICE: 1983 421 428 3380

NOTICE

This document has been prepared under the sponsorship of the U.S. Department of Transportation and the U.S. Department of Energy in the interest of information exchange. Opinions expressed are those of the consultant; none of the statements herein should be taken as a policy position of either of the sponsoring agencies. The United States Government assumes no liability for the contents or use of this document. Findings, opinions and conclusions presented in this report represent those of the contractor or, where noted, of individuals interviewed during the course of the study. This document does not necessarily reflect the views of officials in the U.S. Department of Transportation or the U.S. Department of Energy.

DOT-I-83-3

DOT-I-83-32

TECHNOLOGY SHARING

PROGRAM OF THE U.S. DEPARTMENT OF TRANSPORTATION